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USSR REPORT

EARTH SCIENCES

No. 23

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METEOROLOGY

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PHYSICS OF ATMOSPHERE

METEOROLOGY

EVALUATING DISPERSION OF MEAN HEMISPHERICAL TEMPERATURE USING SATELLITE
OBSERVATIONS OF RADIATION BALANCE FLUCTUATIONS

DEMCHENKO, P. F., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] Available materials on the weather variability of the cloud cover,
albedo and outgoing thermal radiation fields make it possible, within the
framework of simple stochastic energy balance models, with some accuracy, to
avaluate the possible influence on the year-to-year variability of global
climate. Accordingly, the author has evaluated the dispersion of year-to-
year fluctuations of mean hemispherical temperature under the influence of
synoptic fluctuations of the radiation balance. The evaluation is made by
two independent methods. In the first case use is made of data from satellite
observations of fluctuations of albedo and outgoing thermal radiation
(D. J. Hartmann, et al., J. ATMOS. SCI., Vol 37, No 6, pp 1233-1250, 1980)
and in the second case, data on fluctuations of the extent (tenths) of cloud
cover (ATLAS KLIMATICHESKIKH KHARAKTERISTIK OBLACHNOSTI PO DANNYM ISZ (Atlas
of Climatic Cheracteristics of Cloud Cover Based on Artificial Earth Satellite
Data)), Obninsk, Gidrometeoizdat, 1979, 299 pages). In this examination the
role of random heat sources is played by synoptic fluctuations of outgoing
thermal radiation and incoming solar radiation. The intensity of these
sources is evaluated on the basis of satellite data. The computed tempera-
ture dispersion values agree in order of magnitude with data published by
other authors concerning the observable climatic variability. The materials
indicate that the synoptic fluctuations of the radiation balance evaluated
using the data in the ATLAS are capable of causing variability of mean
hemispherical temperature comparable with the observable variability. In the
absence of an albedo-temperature feedback these computations are lower evalu-
ations. Indirect computation of the temperature dispersion on the basis of
fluctuation of the extent of cloud cover in some cases leads to considerably
lesser dispersion values. However, with a strong dependence of the radiation
balance on the extent of cloud cover both methods give identical results.
Tables 3; references 16: 9 Russian, 7 Western.
[161-5303]

HORIZONTAL PROPAGATION OF IMPURITY IN STRATIFORM CLOUDS

SKHIRTLADZE, G. I. and YURCHAK, B. S., Institute of Experimental Meteorology

[Abstract] It has been known that there is an extremely intensive horizontal
propagation of impurities in stratiform clouds. This phenomenon has been
observed both during the artificial crystallization of clouds and during
radar observation of passive radar reflectors. Not only is it known that an
accelerated propagation of impurity in a horizontal direction can be caused
by vertical wind shear, but that in 72% of the cases stratus clouds are in a
wind shear region. The purpose of this study was to obtain definite proof
of the influence of wind shear on diffusion in St; this required direct
measurements of the wind profile. An experiment involved radar tracking of
the falling of a corner reflector dropped by an aircraft. This revealed that
the clouds were situated in a region of strong wind shear; above the clouds
there was a temperature inversion and in this layer the temperature gradient
was 2°C/100 m. Other variants of this experiment produced indentical findings.
These results indicate that wind shear can be the most important factor
responsible for the accelerated anisotropic propagation of an impurity
horizontally in stratiform clouds. Figures 4; references 16: 14 Russian
2 Western.
[184-5303]

SPECTROSCOPIC MEASUREMENTS OF TOTAL CO_2 CONTENT IN URBAN AIR BASINS

DIANOV-KLOKOV, V. I. and FOKEYEVA, Ye. V., Institute of Atmospheric Physics,
USSR Academy of Sciences

[Abstract] The article gives the results of application of the integral
spectroscopic method for studying CO pollution of the air basin of several
cities in the USSR and Bulgaria for the years 1973-1980. Information was
sought on its total content as a function of time of day, season, meteoro-
logical conditions and local orography. The extent of the zone of city in-
fluence on pollution of the entire atmosphere was determined. Several
measurement variants were employed. The typical error in such measurements
was +10%. The study was based on mean daily values of CO content measured
under different meteorological conditions over a long period. It was
necessary to ascertain the regional CO background, subject to seasonal and

geophysical variations, in order to discriminate the anthropogenic contribution. As an example, the mean daily CO content in a vertical column of the atmosphere for Moscow and Sofia is given in Fig. 1 and is discussed in detail. There are significant day-to-day variations which are largely determined by meteorological conditions. The Moscow-Sofia data are compared with observations in Yerevan, Novosibirsk, Dnepropetrovsk and Kislovodsk. In all cities there is a maximum at 0900-1000 hours associated with traffic. The formulas and computations given for the zone of city influence reveal, for example, that for Moscow this is 40-30 km. The method for determining the specific intensity of effluent is outlined. There is a good agreement with other evaluation methods. Figures 5, tables 2; references 18: 14 Russian, 4 Western.
[184-5303]

CHARACTERISTICS OF EXCEEDING STIPULATED CONCENTRATION LEVEL IN PLUME FROM STATIONARY SOURCE

VOZZHENNIKOV, O. I. and ZHUKOV, G. P., Institute of Experimental Meteorology

[Abstract] In models of diffusion of an impurity in the surface layer it is usually only the field of the mean concentration which is considered, but this is not adequate for practical purposes since there is a need to know the probabilities of different levels of concentration and also the frequencies and mean duration of exceeding a certain level. Accordingly, the authors have evaluated the characteristics of excesses of a stipulated level of concentration for a scalar impurity in a plume from a local stationary source in the neutrally stratified atmospheric surface layer and described methods for computing these characteristics. In an earlier study (IZV. AN SSSR: FAO, 17, No 6, pp 580-586, 1981) the authors demonstrated that in the atmospheric surface layer there are two possible regimes of concentration fluctuations: "tranient" and "equilibrium." The article analyzes concentrations above the stipulated level for these two regimes. It was found that in the "transient" regime the probability density function for effluent duration can be described by a log-normal distribution, whereas in an "equilibrium" regime the form of this density in limiting cases is obtained from dimensionality considerations. Approximate formulas are derived for this density which correspond to observational data. Figures 3; references 8: 7 Russian, 1 Western.
[184-5303]

MODELING OF ATMOSPHERIC MOVEMENTS AS PROBLEM OF FILTERING OUT OF SHORT
INTERNAL WAVES

ZEYTOUNIAN, R. Kh., Lille University, France

[Abstract] This French author has published many experimental and theoretical
studies on such subjects as an asymptotic derivation of an ageostrophic
model for atmospheric hydrostatic flows. The objective of this new article
is a clarification, on the basis of the Van Dyke asymptotic expansions
method, of some of the principal structures of atmospheric movements in
relation to discussion of the influence of different approximations on the
filtering-out of internal waves. The study is limited to an examination of
movements with a typical scale L not exceeding the scale of synoptic processes.
The approximation of a plane earth is used. The focus is on weather-forming
processes of a synoptic or regional scale for which atmospheric turbulence
processes play a subordinate role. The point of departure is the Kibel'
fundamental principle of simplification of the equations of hydromechanics,
an asymptotic quasigeostrophic expansion making it possible to filter out
meteorological noise (especially acoustic waves) from the solutions of the
equations which is unimportant for weather. This principle has not always
been adhered to rigorously when applying the singular perturbations method.
Accordingly, the primary goal of the author is to demonstrate that in the
simplification of the fundamental equations it is first and foremost singular
perturbation problems which are involved. A number of approximations are
proposed; these were recently used by the author (IZV. AN SSSR: FAO, Vol 15,
No 5, pp 498-507, 1979) in constructing approximate models for lee waves in
a baroclinic adiabatic compressible troposphere. References 24: 8 Russian,
16 Western.
[184-5303]

APPROXIMATION FORMULAS FOR COMPUTING CLOUD DROPLET COLLISION FREQUENCY

NEIZVESTNYY, A. I., Central Aerological Observatory

[Abstract] The solution of the integral coagulation equation is essentially
dependent on the quality of approximating the kernel of that equation. In
cases of gravitational coagulation the kernel of the coagulation equation
is a function of the radii of the interacting droplets, collision velocities
and collision efficiencies. In this article the author derives formulas

which adequately approximate a considerable volume of earlier published experimental data and published numerical computations for three different approaches to study of the collision of two droplets: 1) In the range $10 \leqslant r_1 \leqslant 25 \mu$ m (M. H. Davis, J. ATMOS. SCI., Vol 29, No 5, pp 911-915, 1972; P. R. Jonas, QUART. J. ROY. METEOROL. SOC., Vol 98, No 417, pp 681-683, 1972); 2) In the range of $25 < r_1 \leqslant 40 \mu$m (J. D. Klett, et al., J. ATMOS. SCI., Vol 30, No 1, pp 107-117, 1973); 3) In the range $40 < r_1 < 100 \mu$m (C. L. Lee, et al., J. ATMOS. SCI., Vol 32, No 7, pp 1412-1418, 1978; Vol 33, No 5, pp 873-875, 1976); In the range $100 \leqslant r_1 \leqslant 300 \mu$ m (U. Shafrir, et al., J. ATMOS. SCI., Vol 28, No 7, pp 741-751, 1971). The derived formulas give a quite good approximation of the collision efficiency value in the range $0.05 \leqslant P \leqslant 1$ and for virtually any r_1 agree well with all available experimental data and corresponding computations and therefore can be used in numerical models, including the kinetic equations of droplet coagulation. In many cases these formulas are preferable to tabulated values of the collision efficiency. Figures 1; references 19: 4 Russian, 15 Western.
[133-5303]

INFLUENCE OF SURFACE TEMPERATURE ON DEVELOPMENT OF CONVECTIVE EDDY

BODRONSOV, A. V. and SOLOV'YEV, A. A., Moscow State University

[Abstract] Experiments with a model of a convective eddy were carried out. The critical values of temperature and the angle of entry (the angle at which the flow enters the eddy) were determined in a laboratory model of a convective eddy. The eddy chamber, constructed of aluminum, had a diameter of 20 cm and a height of 20 cm. There were 16 tangential inlets, each with a height of 20 cm and a width of 10 cm. The angle of entry was determined with an accuracy to 0.5°. The simulated underlying surface was heated by a 600-W electric spiral; temperature was kept stable to 1 K and this temperature could be varied from room temperature to 250°. In contrast to other eddy chambers, the mechanical method for reproducing an eddy is eliminated and it is possible to study eddy systems with a definite influence of buoyancy forces. Velocity measurements were made with a laser anemometer; all measurements were made at a distance of 10.5 cm from the underlying surface. Visualization of the eddy by smoke revealed the region in which vorticity was developing. Visual observations and measurements of tangential velocity were made at different surface temperatures and for different angles of entry. It was found that in this apparatus eddies were not formed in cases when the temperature of the underlying surface and the angles of entry were less than some critical values. Curves were plotted showing the relationship of eddy formation to stipulated values of these parameters. For example, in the temperature range 95-150°C for a given angle of entry the velocity profiles virtually coincide, whereas before and after this temperature interval they increase continuously with a temperature increase. The same picture is observed for other angles of entry greater than the limiting values. Figures 3; references 7: 3 Russian, 4 Western.
[133-5303]

CONDITIONS FOR DEVELOPMENT OF HAILSTONE NUCLEI IN CLOUDS

TLISOV, M. I. and KHORGUANI, V. G., High-Mountain Geophysical Institute

[Abstract] The nature and temperature levels of formation of hailstone
nuclei are examined on the basis of experimental studies of their bubbly
structure and the ice-forming activity of the aerosol particles contained in
hailstones. An attempt was made to clarify the nature and conditions of
development of hailstone nuclei in the natural course of their formation and
falling. Two types of hailstone nuclei are examined--large droplets and
graupel--and it is shown that the second type of nuclei is encountered more
frequently. Samples were taken from three hailfalls in the Northern Caucasus
in 1974 and 1975. A total of 150 hailstones were investigated, taking in
virtually the entire range of hailstone sizes. The droplets in all three
hailfalls had frozen in the temperature range -2 -- $-16°C$; 90% of the nuclei
had developed at temperatures above $-10°C$, with the most probable temperature
interval being -6 -- $-10°C$. The transformation of large droplets into hail-
stone nuclei for the most part occurs at temperatures above $-10°C$ as a result
of heterogeneous nucleation of ice. The formation of graupel nuclei is a
more prolonged process than the formation of droplet nuclei and apparently
transpires in conformity to the scheme; primary crystal-sublimation-coagulation-
nucleus. The concentration of potential nuclei in a cloud is 2-3 orders of
magnitude greater than the concentration of hailstones. The results obtained
in this study indicate that only an insignificant percentage of the nuclei
arising at relatively high temperatures are transformed into hailstones.
Figures 1, tables 2; references 18: 11 Russian, 7 Western.
[122-5303]

THERMOPHORESIS OF AEROSOLS WITH SMALL KNUDSEN NUMBERS: THEORY AND EXPERIMENT

FUKS, N. A., Scientific Research Physicotechnical Institute imeni
L. Ya. Karpov

[Abstract] Although the theory of thermophoresis of small aerosol particles
($Kn \gg 1$) agrees well with experimental data, this is not true of large particles
($Kn \ll 0.3$). Different authors have published many theoretical formulas for
the rate of thermophoresis of large particles without supporting their find-
ings with experimental data, indicative of the uncertainty and confusion in

this area. With full consideration of the data published in the literature, which is subjected to thorough critique, the author attempts to clarify the status of this problem, first reviewing the different methods for determining the rate of thermophoresis. After showing that jet methods are encumbered by serious errors, it is concluded that the most dependable method for determining the force acting on aerosol particles in a temperature gradient field is a variant involving the equilibrating of individual particles by an electrostatic force in a Millikan cell with heated upper and cooled lower electrodes. The matter of thermophoresis of very large particles ($Kn < 0.06$) remains unresolved. It is suggested that a reliable experimental solution of this problem is possible by the equilibrating method at high gas pressures when measurements can be made with small particles easily equilibrated in a Millikan cell; such measurements have never been made. Figures 2; references 14: 4 Russian, 10 Western.
[133-5303]

GENERALIZED TRANSFER EQUATION FOR DISTRIBUTION OF PHOTONS BY PATHS AND VERTICALLY INHOMOGENEOUS ATMOSPHERIC GAS ABSORPTION

ROMANOVA, L. M. and USTINOV, Ye. A., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] During recent years it has been customary to solve problems involving selective gas absorption by solution of the nonstationary transfer equation. However, the application of this approach is only possible by reducing the problem to a case when the absorbing gas is uniformly distributed in the atmosphere. Otherwise the length L of a photon is no longer an adequately complete characteristic of its trajectory and gas can be absorbed to different degrees along trajectories with the same photon path lengths. Various attempts have been made to overcome this difficult, but with unsatisfactory results. The authors here examine a generalized approach for the case of gas absorption which is vertically nonuniform. The approach was developed by W. M. Irvine (ASTROPHYS. J., Vol 144, No 3, pp 1140-1147, 1966; Vol 147, No 3, pp 1193-1196, 1967). Characteristics discriminating narrower sets of photon trajectories (specific photon paths) are introduced. The density of photon distribution by specific paths is introduced; a very simple special case of this is the density of photon distribution by path lengths. An equation is derived which describes the density of photon distribution by specific paths, a generalization of the nonstationary radiation transfer equation. This equation is derived in two forms; in partial and variational derivatives. Applications to vertically inhomogeneous atmospheric gas absorption are discussed. References 10: 5 Russian, 5 Western.
[133-5303]

NONLINEAR THERMAL WAVES FROM HORIZONTAL SOURCES IN NEUTRALLY STRATIFIED
MEDIUM

VUL'FSON, A. N. and INGEL', L. Kh., USSR Hydrometeorological Center

[Abstract] The turbulent convective transport of heat from horizontal
sources in a neutrally stratified atmosphere is examined in detail. The
approach used by the author involved finding self-similar solutions for the
nonlinear equations of turbulent diffusion parameterizing the process of
convective propagation of heat from horizontal sources. Among the special
cases examined here is a nonstationary (especially, instantaneous) heat
source in a medium at rest and a linear stationary source oriented perpendicu-
lar to a homogeneous flow of the medium. It is clearly shown that the
solutions obtained represent thermal waves with a clearly defined front which
propagate with a finite velocity, the latter being dependent on the intensity
of the sources. Proceeding on this basis it is then possible to solve the
problem of the transport of a passive impurity in the field of this thermal
wave. Figures 2; references: 7 Russian.
[133-5303]

INVESTIGATION OF ATMOSPHERIC MOVEMENTS IN CORIOLIS FORCE FIELD IN PRESENCE
OF MOUNTAINS

KHVEDELIDZE, Z. V., Tbilisi State University

[Abstract] The various effects of mountain ranges on macroscale processes in
the Cariolis force field were investigated using a system of equations in
hydrothermodynamics on the assumption of quasistaticity and quasiadiabaticity
of atmospheric processes. The Rocky Mountains and the Caucasus were used as
examples. These ranges were selected because they differ completely in their
orientation relative to the meridians and circles of latitude, the first
being almost north-south and latter being almost east-west; the extent of the
Rockies along the meridian is 20 times greater than the extent of the Caucasus
in this same direction. As a result, the Rossby effect and the effect from
the configuration of the range profile are clearly manifested in different
ways. It was found that qualitatively at all levels in the troposphere
virtually the same pattern is observed: over the Caucasus the influence

functions assume minimum values in a northerly direction and maximum values in southerly and southwesterly directions. With an increase in the horizontal extent of the ranges their influence on the Green's function increases but the degree of the influence of the mountains is dependent on the direction of the flows relative to them. With an increase in time the zero isoline at all levels moves from west to east. The influence of the mountains and the β-effect increases with time. These factors exert a greater effect for mountains extending along the meridian than for those extended along the parallel. With small t values the influence of the β-effect is insignificant, but with an increase in time the influence of Coriolis force variability increases with latitude. Figures 2, tables 1; references: 4 Russian.
[133-5303]

EFFECT OF ANTARCTIC CONTINENT ON ATMOSPHERIC CIRCULATION IN SOUTHERN HEMISPHERE SUBTROPICAL LATITUDES

RUDYAYEV, F. I.

[Abstract] A study was made of the influence of intraannual air exchange between the northern and southern hemisphere and the presence of the high and extensive Antarctic continent on changes in atmospheric pressure in the subtropical latitudes of the southern hemisphere. It is demonstrated that in the southern hemisphere winter the great mass of air flowing from the northern hemisphere should favor forming of a crest of a standing pressure wave in the polar region. However, the Antarctic continent, having an enormous mass, excludes from the seasonal circulation an atmospheric mass of corresponding magnitude. The cyclonic activity in the region of the Antarctic Low, intensifying in winter, also blocks the propagation of atmospheric masses into the southern hemisphere high latitudes. As a result, the air masses moving from the summer northern hemisphere into the winter southern hemisphere are concentrated in the subtropical region, favoring an increase in atmospheric pressure there. The high, extensive Antarctic continent pushes the crest of the pressure wave into the lower latitudes. The standing pressure wave in the southern hemisphere becomes shortened and its crest is situated in the subtropical region. Accordingly, instead of an atmospheric pressure minimum, a pressure maximum is observed in the subtropics. As a result, the atmospheric pressure maximum in the subtropical regions of the northern and southern hemispheres sets in simultaneously in July-August. Since the volume of the Antarctic continent above sea level is about twice as great as the air volume passing from the summer northern hemisphere into the winter southern hemisphere, the subtropical region of increased atmospheric pressure pushes the equatorial trough to 2°30'N. Evidently, without existence of the Antarctic glacier the subtropical atmospheric pressure maximum in the southern hemisphere in winter would be

expressed more weakly than is observed even in summer of the modern epoch. The region of the Antarctic Low in winter would be displaced to the north and possibly come into contact with the equatorial trough. As a result, in place of the modern subtropical region of increased pressure in the southern hemisphere in winter there would be increased cyclonicity. The equatorial trough in winter would not move into the northern hemisphere as it does now. In addition, Antarctica can exert an influence on change of the moment of inertia of the earth-atmosphere system, and therefore, on the earth's rotation. Figures 1; references: 8 Russian.
[140-5303]

CHANGE IN CLIMATE AND MOUNTAIN GLACIATION IN NEW ERA (INTERNAL STRUCTURE OF 1850-YEAR RHYTHM)

MAKSIMOV, Ye. V.

[Abstract] The behavior of mountain glaciation was examined in relationship to the 1850-year rhythm of geographical phenomena (this rhythm has two phases--rapidly and vigorously developing cool-moist phase with a duration of 300-500 years and a slowly developing dry and warm phase with a duration greater than a thousand years). Mountain glaciation in its advances and retreats conforms to this rhythm. This particular rhythm fits perfectly into the 40 700-year rhythm described by the author in his monograph PROBLEMY OLEDENENIYA ZEMLI I RITMY V PRIRODE (Problems in the Earth's Glaciation and Natural Rhythms), Leningrad, Nauka, 1972); Figure 1 is a diagram of the climatic-glacial structure of the 40 700-year rhythm. In this article an attempt is made to clarify the internal structure of this rhythm by constructing a theoretical model; this is shown as Fig. 2 (the following elements are incorporated in the model: variation of heat receipts; variation of moisture; dessications; inversion periods; changes in C^{14} content in atmosphere. Using this model it was possible to compute the chronological position of all the moist stages associated with the decay of glaciers in the last glacial era (these computed data are summarized in a table). The computed chronology of moist stages is convincingly confirmed by the behavior of glaciers in Alaska and in the Alps. The data confirm that there is a polyphase noncoincidence of the course of heat supply and the course of moistening. The existence of "moist" and "cold" stages in the development of mountain glaciation is confirmed. During the 1850-year rhythm there are intervals and semi-intervals with different relationships between heat and moisture. There is an opposite variation of the change in moistening in the humid and arid zones within the defined intervals and semi-intervals. There is a distinct correlation between the 1850-year rhythm and the variation in C^{14} content in the earth's atmosphere. Figures 2; tables 1; references 27: 13 Russian, 14 Western.
[140-5303]

ALL-UNION CONFERENCE ON PRACTICAL ASPECTS OF TURBULENT DIFFUSION IN
ATMOSPHERIC SURFACE AND BOUNDARY LAYERS (OBINSK, 5-9 OCTOBER 1981)

BYZOVA, N. L.

[Abstract] The 1st All-Union Conference on Practical Aspects of Turbulent
Diffusion in the Atmospheric Surface and Boundary Layers was held in Obninsk
during the period 5-9 October 1981. The conference was attended by 120
persons from 25 organizations representing 15 ministries and departments. A
total of 64 reports were presented at the plenary and sectional meetings.
The content of the reports had an emphatically practical character. The
reports did reveal a diversity of theoretical approaches: in addition to
the traditional application of the so-called K theory there was extensive
use of statistical approaches and similarity theory. About one-third of the
reports dealt with diffusion in the surface and boundary layers and boundary
layer models; half that number were devoted to diffusion over a complex under-
lying surface; about 15% covered the practical aspects of contending with
atmospheric contamination; about 20% discussed methodological problems and
instrumentation. This conference summary lists each speaker, the subject of
their reports and a few sentences describing their content. The reports make
clear that there has been much progress in theoretical and experimental in-
vestigations of diffusion, including under conditions of a nonuniform under-
lying surface and in vegetation, development of methods for computing air
contamination by effluent from factories and determining the maximum admissible
concentrations, formulation of methods for taking meteorological characteris-
tics into account and including them in the computation models. It is clear
that scientific research is lagging behind practical needs in the devising of
methods for computing the scattering of impurities in mining and coastal
regions.
[193-5303]

VERTICAL PROFILES OF TURBIDITY COEFFICIENT AND DEGREE OF POLARIZATION OF
SCATTERED SOLAR RADIATION IN EQUATORIAL LATITUDES

KUZNETSOV, G. I., CHIZHOV,A. F. and SHTYRKOV, O. V., Central Aerological
Observatory

[Abstract] A series of launchings of M-100N meteorological rockets with
optical instrumentation took place on the 23d voyage of the research ship
"Akedemik Shirshov" in the equatorial Indian Ocean for measuring solar

radiation scattered from the zenith. The measurements were made on the ascending segment of the trajectory when the rocket was spatially oriented by rotation with an accuracy to $\pm15°$. The dates of launchings, solar zenith angles and geographical coordinates for these launchings are given in Table 1, together with some technical specifications of the instrumentation. Two observations were in the UV region and the other eight in the visible region. Measurements began at an average altitude of 30 km; the data apply to altitudes 30-70 km. Simultaneous launchings were made to determine thermodynamic parameters at altitudes 20-80 km. Table 2 gives the vertical profiles of the turbidity coefficient. For the equatorial zone these profiles remain virtually constant with altitude. Light scattering in the stratosphere and lower mesesphere occurs considerably more intensively than would be expected in the presence of a pure molecular atmosphere. The turbidity coefficient varies greatly from launching to launching, reflecting the principal property of the aerosol component at these altitudes (its variability). Figure 1 is a comparison of the vertical profiles of the averaged turbidity coefficient and the dispersion of the turbidity coefficients for the equatorial and middle latitudes. Figure 2 shows vertical profiles of the degree of polarization of scattered radiation in the equatorial zone. The degree of polarization is more variable with altitude than the turbidity coefficient. Figures 2, tables 2; references 4: 3 Russian, 1 Western.
[193-5303]

NUMERICAL MODELING OF HEAT AND MOISTURE TRANSPORT IN ATMOSPHERIC CONVECTION

PUSHISTOV, P. Yu., GINZBURG, A. S., MAL'BAKHOV, V. M. and KONONENKO, S. M., West Siberian Regional Scientific Research Institute; Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] This study is based on earlier research by the authors (IZV. AN SSSR: FAO, Vol 16, No 1, pp 3-10, 1980) in which they developed a two-dimensional numerical model of two-level moist convection with the formation and development of cumulus clouds. The convective elements participating in the redistribution of heat, moisture and momentum exert an influence on macroscale atmospheric processes and their combined effect leads to changes in the vertical distributions of temperature and humidity. In this article these changes are evaluated in dependence on different physical factors, using the same two-dimensional numerical hydrodynamic model. Although the main physical factors determining the development of convective clouds are dynamic processes and the energy of phase transitions, allowance is also made for heat influxes due to long-wave radiation. Computations were made with stipulation of different external parameters. In addition, the paper gives the results of three variants of computations with identical parameters and successive inclusion of new physical processes. 1) dry convection: phase

transitions are absent, moisture is transported by convective elements as a passive admixture; 2) moist convection: condensation and evaporation of water vapor occurs with formation of a second level of convection; 3) moist convection with radiation taken into account. It was found that the total convective heat flow has two maxima--at the lower condensation level and above the condensation level. The convective flow of moisture has only one maximum corresponding to the lower heat flow maximum. Moist convection substantially smooths the temperature and moisture (humidity) profiles in comparison with the model of dry convection. Allowance for long-wave radiational cooling of the upper and heating of the lower boundary layers of clouds leads to a further smoothing of these profiles due to an increase in the intensity of the redistribution of heat and moisture. Figures 3; references 9: 7 Russian, 2 Western.
[193-5303]

VERTICAL DISTRIBUTION OF RADIATION HEAT INFLUXES IN CLOUDLESS ATMOSPHERE

FARAPONOVA, G. P., Central High-Elevation Hydrometeorological Observatory

[Abstract] Measurements of the fluxes of short-wave radiation at different levels of the Ostankino TV tower (47, 305 and 503 m) and at the ground level (2 m) were carried out at Moscow in 1977-1978 for investigating the lower 500-m layer of the atmosphere. In determining the radiation heat influx use was made of simultaneous measurements of solar radiation in clear weather at two levels by means of pyranometers or actinometers. The pyranometers were on extensible rods 2-5 m in length so that they would not be shielded by the tower. Using measurements made in stable clear weather it was possible to determine the radiation heating for three layers: 2-503 m, 2-47 m and 47-305 m. Figure 1 shows that the near-midday values of radiation heating in these three layers have close values: in the layer 2-47 m they are 0.55 K/hour, in the layer 47-305m--0.35 K/hour and in the layer 2-503 m-- about 0.4 K/hour. The actually observed temperature changes have maximum which are somewhat higher (up to 1 K/hour) and these are observed at earlier times than the radiation maxima. The actual air heating in the layer 2-503 m begins to increase at sunrise, attains a maximum at about midday and at about 1700 hours becomes equal to 0. Air heating due to short-wave radiation is observed during the period from sunrise to sunset and follows the diurnal variation of solar radiation. The different variation of $(\partial T/\partial t)$ values in the absence of advection is attributable to the fact that in the first half of the day with $(\partial T/\partial t)_{act} > (\partial T/\partial t)_{SW}$ in the lower 500-m layer there is a predominance of convective currents creating an additional turbulent influx of heat due to air heated at the ground, whereas at the end of day with $(\partial T/\partial t)_{act} < (\partial T/\partial t)_{SW}$ there is a predominance of descending turbulent currents favoring the cooling of this layer. Studies of the radiation influx of heat made in the atmosphere reveal a considerable change in

the influx with altitude. This is illustrated in Fig. 2. The vertical profile can be approximated by the expression $(\partial T/\partial t)_{SW} \sim z^{-5/3}$, which is close to the vertical turbulence profile for the boundary layer. Figures 2; references: 7 Russian.
[151-5303]

EXPERIMENTAL STUDY OF TRANSVERSE TURBULENT DIFFUSION IN ATMOSPHERIC SURFACE LAYER

GARGER, Ye. K., MAZURIN, N. F., NAYDENOV, A. V. and UVAROV, D. B., Institute of Experimental Meteorology

[Abstract] The hypothesis of similarity of the Lagrangian characteristics of turbulence in the atmospheric surface layer has afforded new possibilities for computing the transverse dispersion of coordinates, particularly simple relationships being obtained in the case of a neutral stratification. This article describes an experimental testing of one of these relationships. In contrast to an earlier study made by the authors of transverse diffusion in the surface layer (IZV. AN SSSR: FAO, Vol 16, No 4, pp 368-375, 1980), where the investigation dealt with the behavior of relative dispersion of coordinates as a function of the distance and time of diffusion, this article examines the transverse absolute dispersion of coordinates of impurity particles. The experimental conditions were fully described in the earlier article. The experiments were carried out in three polygons: the first was a level area surrounded by agricultural fields, the second was an area with traces of ox-bow lakes, solonchak soil and semidesert vegetation, and the third was a sandbar about 1 km in width surrounded by water. Most experiments were conducted when there was a neutral or weak unstable stratification. The data agree well with the conclusion drawn from the similarity hypothesis that $\sigma_y^2(t) = \alpha_y u_* t^2$, where α_y^2 is the transverse absolute dispersion of coordinates and α_y is a universal constant. The experimentally determined α_y values were substantially different for the three polygons. These differences were probably attributable to differences in mesoroughness of the polygons. Figures 4, tables 1; 8 Russian, 1 Western.
[151-5303]

FACTORS IN FORMATION OF LARGE AIR TEMPERATURE ANOMALIES IN JANUARY OVER
TERRITORY OF FOREIGN EUROPE

BUKINA, I. B. and SOROKINA, V. N.

[Abstract] Considerable and systematic air temperature variations in the
northern hemisphere occur at latitudes to the north of 40°N. The authors
investigated air temperature anomalies over the territory of foreign Europe.
An analysis was made of major mean monthly air temperature anomalies for
January using data for 26 stations scattered in foreign European having an
80-year observation series (1881-1960). During this period in January there
were only 8 years with large negative temperature anomalies. In these cold
Januaries there was a predominance of an easterly type of circulation,
meridional circulation being of secondary importance. An easterly type of
circulation, during which there is advection of cold air from the east, is
determined primarily by stationary anticyclones forming at the earth's surface
in the northern part of European Russia or Western Siberia and moving in
southerly and sourthwesterly directions into the southern latitudes. The
easterly type is also observed when the spur of the Asiatic anticyclone moves
on Europe. In the case of meridional circulation cold air masses from the
Arctic Basin intrude along the eastern periphery of anticyclones developing
in Scandinavia and Greenland, imparting severity to the climate of Europe.
With respect to extent of territory negative anomalies can be classified into
two types, which are discussed here in detail. The temporal distribution of
negative anomalies over the 80-year period has no definite pattern. For
example, three of the nine anomalies occurred one after another--in 1940,
1941, 1942; in the first case an easterly form of circulation predominated,
in 1941--meridional, in 1942--a combination of easterly and meridional. The
discussion of the anomalously cold Januaries is followed by a corresponding
examination of the 11 years during the considered period which were character-
ized by positive air temperature anomalies, which usually are observed when
a westerly type of circulation predominates. Under these conditions cyclonic
systems move over Europe to the east and northeast, causing an intensified
transport of warm and moist air masses from the ocean to the continent.
Positive anomalies are of two classes--forming with a predominance of westerly
circulation and forming under the joint influence of westerly and easterly
forms of atmospheric circulation. Positive anomalies can be classified into
two types on the basis of the area involved. Figures 2, tables 3; references:
6 Russian.
[162-5303]

MATHEMATICAL MODELING METHOD FOR STUDYING INFLUENCE OF MAJOR CITIES ON
ATMOSPHERIC METEOROLOGICAL REGIME AND POLLUTION

BELOV, P. N. and SHCHERBAKOV, A. Yu.

[Abstract] The article examines some methods for the modeling of atmospheric
contamination processes and changes in the meteorological regime of pollution
in major cities. First the authors present their own model. It is assumed
that the influence of major cities on the state of the atmosphere can be
traced only within the planetary boundary layer with a height of about 1-2 km.
In the case of a city with an area measuring 50 x 50 km for solution of the
formulated problem it is adequate to study a sector of the atmosphere with
horizontal dimensions of hundreds of kilometers and vertical measurements of
1-2 km. The equations of hydrothermodynamics of mesoprocesses are applicable.
The case examined is limited to the modeling of meteorological processes and
propagation of impurities over a 24-hour period. The values of the meteoro-
logical elements and the concentration of atmospheric impurities outside the
mesometeorological polygon are assumed known. The distribution and intensity
of sources of pollution and the physical properties of the underlying surface
must be stipulated. After introducing a series of other simplifying assump-
tions a system of equations is written which is closed and includes seven
known parameters. Initial and boundary conditions are written. This system,
due to its exceptional complexity, cannot be solved analytically and there-
fore must be solved numerically. A spatial grid of points is introduced. By
means of numerical integration of finite-difference equations in time the values
of all the sought-for functions are found at the points of grid intersection
at different moments in time. Other different theoretical schemes for
modeling atmospheric pollution processes in large cities are compared--those
published by N. S. Vel'tishchev, G. I. Marchuk, M. A. Atwater, T. W. Yu. and
N. K. Wagner. References 10: 5 Russian, 5 Western.
[162-5303]

NUMERICAL MODEL FOR INVESTIGATING INTERACTION OF ATMOSPHERIC MOVEMENTS AT
DIFFERENT SCALES IN TROPICAL ZONE

MOSTOVOY, G. V.

[Abstract] Numerical modeling is particularly effective in studying the
interaction of macroscale wave disturbance with processes of mesoconvective
and convective scales. Accordingly, the author formulated a model which

reproduces the interaction of macroscale currents with cumulus clouds, con-
stituting convective-scale movements. In this model there are mutual changes
of both macroscale temperature fields and the kinematic characteristics of
horizontal velocity (vorticity and divergence) and the thermodynamic para-
meters of the cumulus convection process. The basis for the proposed model
is dynamic equations describing macroscale movement through vorticity and
velocity divergence. Two simple equations form the basis of the model, making
it easy to describe the three-dimensional disturbance pattern on the basis of
a series of macroscale fields with a stipulated Q(p) and (Q(p) is the vertical
profile of nonadiabatic heating of the atmosphere due to cumulus clouds). The
Q(p) profile is not some constant, but changes with time. The model then
makes it possible to study the process of interaction between cumulus clouds
and macroscale currents. The approach has significant advantages, making it
possible to trace the temporal change of thermodynamic characteristics for
different types of clouds and the change in the cloud spectrum itself. With
certain assumptions it is possible to evaluate the extent of convective cloud
cover. However, the application of the computation scheme requires solution
of a Fredholm integral equation of the first kind with a complex kernel,
making a numerical solution extremely difficult, thus constituting a serious
obstacle in practical use of the method, especially in multilevel studies.
Thus, not all the advantages of the method can be applied at the present
time. It is noted that the scheme does not solve all the problems related
to the mechanism of cumulus convection in the tropics. For example, it does
not take into account the possibility of formation of convective clouds with
bases in the free atmosphere and this type of convective cloud formation in
characteristics for the tropical atmosphere. Figures 1; references 11:
5 Russian, 6 Western.
[199-5303]

COMPARISON OF OPTICAL AND ELECTROCHEMICAL METHODS FOR INVESTIGATING VERTICAL
OZONE DISTRIBUTION

BREZGIN, N. I., CHIZHOV, A. F., SHTYRKOV, O. V., VELLER, M., LAITERER, W.,
SHTEINHAGEN, G. and GERNANDT, H., USSR Central Aerological Observatory and
Aerological Observatory, Lindenberg, GDR

[Abstract] The article gives the results of direct comparisons of methods
for investigating the vertical distribution of the ozonosphere: determina-
tion of this parameter by the optical absorption method on meteorological
rockets and by the electrochemical method on balloons. The experiments were
carried out under a program of the "Intercosmos" Council by specialists of
the Central Aerological Observatory in the USSR and the Aerological Observa-
tory of the East German Meteorological Service; the experiments were made
both in the middle latitudes and in the tropics. At Volgograd measurements

were made in 1976 and 1978 at altitudes from 20 to 40 km at wavelengths
0.31-0.30 μm. The results of these investigations by the optical and electro-
chemical methods were in good agreement qualitatively and quantitatively.
The maximum deviations of the results did not exceed 10-15% at altitudes
20-30 km. Strong short-period fluctuations of the vertical distribution of
ozone were detected. The measurements in the tropics were made in April-May
1979 during the experiment MONEX-79 (23d voyage of the scientific research
ship "Akademik Shirshov." These measurements were at 0.3 μm and all launch-
ings were at a solar zenith angle 75°. At 25-30 km the ozone densities
measured by the different methods did not differ by more than 10%. However,
at 20-25 km the rocket data were systematically lower than the balloon data
by an average of 20%, this evidently being attributable to the influence of
scattered radiation. In general, these series of measurements by the two
methods not only confirmed the correctness of both methods, but also pro-
vided much new data concerning ozonospheric processes. Figures 2; references
10: 5 Russian, 5 Western.
[174-5303]

DETERMINING VERTICAL WIND VELOCITY PROFILE FROM THERMAL SOUNDING DATA

ALESHIN, V. I. and PARINA, O. A., Gor'kiy Scientific Research Radio Physics
Institute

[Abstract] Since measurements of atmospheric radiothermal radiation in the
oxygen absorption line λ = 5 mm make it possible to find the vertical tempera-
ture profile, these data can serve as a basis for computing the horizontal
temperature gradient and accordingly find the vertical velocity profile for
the thermal wind. The applicability of the method is dependent on the errors
in determining velocities. These errors consist of the errors in recon-
structing the vertical temperature profile on the basis of radio measurements
and the errors in approximating horizontal geopotential gradients on the basis
of data from a small number of stations. The latter is more important and
is examined in depth. A graph was constructed which shows that the error in
determining wind velocity does not exceed 1 m/sec at the level P = 840 mbar
if the distance between the limited number of stations is $r \geqslant 100$ km. At
altitudes P = 700 mbar ($\sim$3000 m) this requires distances $350 < r < 100$ km.
The optimum distances between stations is in the range 400-600 km. Another
graph was constructed for the errors in wind velocity with distances between
stations of 100 and 600 km. This graph shows that the error increases
monotonically with altitude. At the level P = 840 mbar with r = 600 km this
error ranges from 0.3 to 0.7 m/sec. With distances r = 100 km the error in
determining velocity exceeds 1 m/sec at 800 mbar, whereas with r = 600 km such

a situation arises only at 630 mbar. It is concluded that the proposed method makes it possible to determine the velocity of the thermal wind to altitudes of about 3 km. Figures 2; references 11: 8 Russian, 3 Western.
[174-5303]

INVESTIGATING DISPERSION AND ICE-FORMING ACTIVITY OF SILVER IODIDE AEROSOLS GENERATED BY PYROTECHNIC MIXTURES

BAKLANOV, A. M., GORBUNOV, B. Z., KAKUTKINA, N. A., KRAVCHENKO, I. P., KUTSENOGIY, K. P., SIDOROV, A. I. and PASHCHENKO, S. E., Institute of Chemical Kinetics and Combustion, Siberian Department, USSR Academy of Sciences

[Abstract] In earlier studies by the authors it was demonstrated that for a silver iodide aerosol produced in a quartz generator the ice-forming activity is determined by its dispersion and crystal structure. It was postulated that in pyrotechnic mixtures ice-forming activity will also be determined by these same two factors. The authors, in order to verify this assumption, investigated the dispersion, crystal structure and ice-forming activity of particles obtained using pyrotechnic mixtures with different silver iodide contents. Mixtures with an AgI content of 2, 4, 10 and 41% were investigated. The aerosols were generated by combustion of 0.1-g samples in a cube with a volume of 250 liters. The crystal structure was determined using an electron-diffraction camera and an x-ray diffractometer. It was found that the crystal structure of AgI particles generated in the pyrotechnic mixtures was the same as for particles obtained from pure reagent and is dependent only on the size of the particles. At least for those mixtures in which the combustion products do not modify the surface of the particles the dependence of the ice-forming activity on particle size is the same as for particles obtained from pure reagent. For particles generated from pure reagent the ice-forming activity of the mixtures is determined for the most part by the dispersion of the AgI particles. This suggests that the maximum yield of ice crystals per gram of AgI in the mixtures will be attained as in the case of pure AgI with a mean cubic diameter of the particles 260 A. Figures 4, tables 1; references 9: 7 Russian, 2 Western.
[174-5303]

SPATIAL CORRELATIONS OF CLOUD DROPLET SPECTRUM FLUCTUATIONS DURING CONDENSATION

STEPANOV, A. S., Institute of Experimental Meteorology

[Abstract] A generalization of the kinetic equation for the diffusional
growth of droplets in the absence of atmospheric turbulence is presented.
Specifically, equations are derived for the space correlation functions of an
ensemble of droplets in an aqueous aerosol growing in size in the condensa-
tion process. A solution of these equations is given for a homogeneous
medium and space correlators of fluctuations of the vapor field and the
moments of the cloud droplet spectrum are found. The author outlines materials
indicating that there is a structuring of the medium with a characteristic
spatial dimension $r = (4 \pi nR)^{-1/2}$, where n is the droplet concentration, R
is mean droplet radius. The computations presented here demonstrate that
the observed correlations have an essentially non-Poisson character and in-
crease with an increase in droplet size with a specific characteristic time.
It is stressed that it is important and necessary to make allowance for these
correlation functions when a physical effect is caused by medium inhomogenei-
ties. The microstructuring of aerosol must be taken into account in any
examination of the scattering of electromagnetic radiation and in any analysis
of the process of generation of precipitation. References 8: 7 Russian,
1 Western.
[174-5303]

RADAR DETECTION OF HAIL

ABSHAYEV, M. T., High-Mountain Geophysical Institute

[Abstract] This review gives a systematization and comparative analysis of
the possibilities, merits and shortcomings of radar methods for detecting
hail. Single-wavelength statistical methods for the identification of hail
clouds on the basis of their macrophysical characteristics, assuming the
choice of the optimum complex of parameters and optimum processing of infor-
mation, ensure a reliability and accuracy of recognition, evaluation of a
prehail state of clouds and determination of the time of transition of a
cloud into the hail state. The use of radars with $\lambda = 10$ cm is most effective
for this purpose. Two-wavelength methods for detecting hail centers (differ-
ence and differential methods) make possible a routine recognition of hail
clouds, the discrimination of hail centers and the suppression of interfering
reflections from local features and accordingly they constitute one of the

most informative methods employed in hail protection. The polarization method for detecting hail and hail centers on the basis of polarization and reflectivity characteristics is promising but requires further development and experimental checking. Doppler information can be used in detecting hail only in the case of large sounding angles and has ambiguity associated with broadening of the Doppler frequency spectrum due to the influence of turbulence. The radar-radiometric method for detecting hail when using a 10-cm radar and a long-wave radiometer (λ =5.6-8.5 cm) ensures reliable hail detection but does not have practical value due to its limited effective range, although it can be used in studying the growth regime of hail. A determination of the prehail state of clouds is ensured by statistical methods. Figures 6, tables 1; references 15: 11 Russian, 4 Western. [174-5303

METHODS FOR OPTIMIZING PARAMETERS OF NUCLEAR MAGNETOMETER SENSORS

VERZHBITSKIY, Ye. V., NAYMARK, L. M. and BELYAYEV, I. I., Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] The principal requirement imposed on the characteristics of a nuclear magnetometer sensor, which determines measurement accuracy, is accurate determination of the maximum amplitude of the precession signal. In addition, change in the strength of the precession signal must be minimum during different directions of ship movement; the sensor must have the least possible dependence on orientation. At present solenoidal single-coil systems, a system of two solenoidal coils whose axes are mutually perpendicular and toroidal sensors are used in nuclear magnetometers. This article gives a thorough discussion of means for optimizing the principal parameters of solenoidal sensors and ways to enhance nondependence on orientation. This is essential because the noise immunity of nuclear magnetometers is determined to a great extent by the design of the sensor and its individual components and its dependence on orientation. Many design variants were examined theoretically and experimentally. The maximum change in strength of the precession signal for a two-coil solenoidal sensor (like for a toroidal sensor) in dependence on spatial orientation is ~50%. An expression is derived for the orientation dependence of such a system. The sensor for a nuclear precession signal consisting of three solenoids whose axes are mutually perpendicular has a new qualitative characteristic in comparison with single- and two-coil sensors: virtually no dependence on orientation. Accordingly, at the input of the nuclear magnetometer amplifier the signal-to-noise ratio remains constant, resulting in a measurement of better quality. The parameters of the recommended sensors are given in Table 1 and 2. Figures 4, tables 2; references: 3 Russian.
[171-5303]

EVALUATION OF CONCENTRATION OF BLACK SEA JELLYFISH, CTENOPHORA AND CALANUS
ACCORDING TO OBSERVATION FROM 'ARGUS' SUBMERSIBLE

VINOGRADOV, M. Ye. and SHUSHKINA, E. A., Institute of Oceanology imeni
P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] The use of manned submersibles makes it possible to determine the
true numbers of plankton animals and clarify their quantitative and spatial
distributions, information which cannot be obtained by other methods. Obser-
vations of this type were made from the submersible "Argus" in late September-
early-October 1981 at two points in the eastern part of the Black Sea. Point
1 was 3 miles from the shore over a depth of 45-50 m; point 2 was at a dis-
tance of 6 miles from the shore over a dropoff with depths of 500-1000 m.
The purpose of the work was to ascertain the numbers of jellyfish Aurelia
aurita, to clarify the details of their vertical distribution and its depend-
ence on external factors, to compare the true concentration of jellyfish
obtained by direct observations with its estimate based on catches with
plankton nets, to estimate the numbers and ascertain the pattern of vertical
distribution of Calanus helgolandicus in layers over the hydrogen sulfide
zone, as well as the corresponding parameters for the ctenophora Pleurobrachia.
These observations revealed that Medusa live in the upper mixed and in the
gradient layers. According to direct observations their numbers were three
times greater than indicated by plankton net counts, the number being 13
specimens/m^2. During the daytime Calanus forms concentrations in the lower
part of the oxygen zone. The layer of maximum concentration, exceeding 3500
specimens/m^3, has a thickness of about 1 m and lies at the lower boundary of
distribution of the population. The ctenophora form concentrations in the
zone of maximum numbers of Calanus, which they eat, but do not penetrate to
the depth of its greatest concentrations. Figures 4, tables 2; references 13:
8 Russian, 5 Western.
[171-5303]

AREAS OF OCCURRENCE OF DIFFERENT TYPES OF RECENT MARINE SEDIMENTS

LEONT'YEV, O. K. and BELODEDENKO, M. V., Moscow State University imeni
M. V. Lomonosov

[Abstract] During recent years specialists in the marine geomorphology
laboratory of the Geography Faculty, Moscow State University, have compiled
a map of bottom deposits of the world ocean for academic purposes at a scale

of 1:20 000 000, that is, several times more detailed than any earlier pub-
lished maps of this type. A special map projection was used which ensured
the property of equivalence while allowing only minimum distortions of
coastal outlines of the oceans. The cartographic base is constructed in the
form of three lobes joined in the region of Antarctica: the greatest dis-
tortions of angles are concentrated in the marginal zones of these lobes,
which are the continental parts of the map. An additional advantage of this
projection is that both the northern and southern polar regions are depicted
simultaneously, which is not possible when using any other projection. The
sources used in map compilation were foreign and Soviet maps and articles,
monographs and reference works; no raw data or original investigations were
used. The system of symbols employed was based on the classification of
bottom deposits published by the Institute of Oceanology in 1960. Figure 1
is a reproduction of the compiled map. The nature of the projection clearly
reveals the latitudinal zonality of occurrence of the main types of marine
deposits. The equivalence of the projection makes possible the direct measure-
ment of map areas occupied by different types of bottom deposits. These
measurements were made using an electronic planimeter. This made it possible
to compile a table of the areas of occurrence of different types of bottom
sediments in the world ocean. It was found that calcareous sediments are
more widespread than believed earlier. Abyssal red clay occupies a lesser
area than indicated on earlier maps. A very widespread occurrence of
terrigenous deposits is also obvious. The areas of a number of types of
sediments have been represented for the first time: shallow-water terrigenous
deposits, mixed calcareous-siliceous deposits, and others. Figures 1, tables
1; references 18: 16 Russian, 2 Western.
[171-5303]

EFFECT OF HYDROSTATIC PRESSURE AND TEMPERATURE ON SOLUBILITY OF MAIN
COMPONENTS OF FERROMANGANESE NODULES

AFANAS'YEV, Yu. A., YEREMIN, V. P. and RYABININ, A. I., Kuban State University,
Krasnodar

[Abstract] The authors made an experimental evaluation of the influence of
hydrostatic pressure on the solubility of the main components of ferromanganese
nodules $Fe(OH)_3$ and $Mn(OH)_4$ to pressures of 600 kg·cm^{-2} and to temperatures
8°C under laboratory conditions. In an earlier study (Yu. A. Afanas'yev,
et al., ZH. FIZ. KHIMII, Vol 53, No 8, pp 1960-1962, 1979) it was demonstrated
that the solubility of these components at a pressure of 500 kg·cm^{-2} is con-
siderably less than the solubility of these compounds at ordinary pressure
in the temperature interval 25-8°C. The experimental method used in that
investigation has been applied in this new study. Table 1 gives the solubility
of the two components at different temperatures and pressures. The table shows

that the solubility of the compounds decreases with both a decrease in temperature and with an increase in hydrostatic pressure. It is also clear that at high hydrostatic pressures the process of dissolving of a nodule in sea water is thermodynamically reversible. The experimental study of the solubility of $Fe(OH)_3$ and $Mn(OH)_4$ in NaCl and $NaSO_4$ solutions, as well as the solubility of nodules in sea water and an Na_2SO_4 solution at hydrostatic pressures of 1-600 $kg \cdot cm^{-2}$ and temperatures 8-25°C, has cast new light on the mechanism of formation of ferromanganese nodules in the world ocean. Tables 2; references: 1 Russian.
[171-5303]

CALCULATION OF SPECTRAL VALUES OF SEA WATER LIGHT ATTENUATION COEFFICIENT IN 270-590 nm REGION ACCORDING TO MEASUREMENT DATA FOR TWO WAVELENGTHS

KOPELEVICH, O. V., Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] In an earlier study the author demonstrated that it was possible to "reconstruct" the scattering coefficient of sea water $\sigma(\gamma)$ using measurement data for only two or three scattering angles using a system of eigenvectors of the covariation matrix $_B[\lg \sigma(\gamma_1), \lg \sigma(\gamma_j)]$. In this article a similar possibility is examined for the spectral dependences of the attenuation coefficient $\varepsilon(\lambda)$ in the region 270-590 nm. The measurement data were collected on the 61st voyage of the "Vityaz'" with the "Okean" instrument which makes it possible to measure the $\varepsilon(\lambda)$ value continuously in the spectrum with a resolution 3.5 nm in the visible region and 8 nm in the UV region. The possibility of "reconstructing" the $\varepsilon(\lambda)$ values using data for only several wavelengths is dependent on the interrelation of variation of these parameters with different λ values. This interrelationship was evaluated by correlation analysis. The contribution of the eigenvalues of the covariation matrices $B[\varepsilon(\lambda_i), \varepsilon(\lambda_j)]$ to the total dispersion was also evaluated. The statistical processing of the measured spectral dependences $\varepsilon(\lambda)$ was carried out for values of these indices at wavelengths 390-590 nm and separately for 270-390 nm with a discreteness 20 nm. Examples of "reconstruction" of the total $\varepsilon(\lambda)$ spectra from $\varepsilon(390)$ are given. In computing $\varepsilon(\lambda)$ by the proposed method it is not essential to use $\varepsilon(390)$ and $\varepsilon(550)$. It is also possible to use another pair of wavelengths, provided that one of them is in the short-wave part of the spectrum ($\lambda_1 \leqslant 400$ nm) and the other in the long-wave part ($\lambda_2 \geqslant 500$ nm). The results presented in this paper must be taken into account when developing apparatus intended for investigating the spatial-temporal variability of the attenuation coefficient. The mean error for the described computations is ~ 0.01 m^{-1} in the visible and ~ 0.04 m^{-1} in the UV region. Figures 3, tables 3; references 6: 5 Russian, 1 Western.
[171-5303]

DIURNAL VARIABILITY OF VERTICAL PROFILES OF SUSPENDED MATTER AND HYDROOPTICAL
CHARACTERISTICS IN OCEAN SURFACE LAYER

VASIL'KOV, A. P., Institute of Oceanology imeni P. P. Shirshov, USSR Academy
of Sciences, Moscow

[Abstract] Data in the literature on the diurnal variability of fluorescence,
chlorophyll, phytoplankton and primary hydrooptical characteristics indicate
a substantial difference between them. This is particularly true of the
amplitude of diurnal variations. The form of the diurnal variations of the
attenuation and scattering coefficients is far more complex than for the
diurnal variations of fluorescence. There is a difference in the time when
the maximum values are attained: The maximum ε and σ values in most cases
are attained in evening and fluorescence at nighttime. The author here, on
the basis of a model formulated by V. I. Burenkov, et al. (IZV. AN SSSR:
FIZIKA ATMOSFERY I OKEANA, No 5, pp 537-544, 1981), gives an analysis of the
diurnal variability of the vertical distribution of the concentration of
biological suspended matter and a comparison is made with experimental data
on the diurnal variability of profiles of hydrooptical characteristics.
(The theoretical model is based on a number of simplifying assumptions of a
hydrophysical and biological nature and therefore it does not take into
account all the diversity of factors forming the vertical profiles of optical
characteristics and determining their diurnal variability.) It is assumed
that the vertical profiles of hydrooptical characteristics in open ocean
areas are determined for the most part by phytoplankton. The model, which
is further refined here, is compared with data in the literature. The
critical review and analysis of the data presented here clearly confirm that
the diurnal variability of optical characteristics is determined by a change
in the concentration of phytoplankton in the course of the day. Figures 2;
references 11: 10 Russian, 1 Western.
[171-5303]

ESTIMATING CHLOROPHYLL CONCENTRATION FROM COLOR INDEX MEASUREMENTS IN
DIFFERENT REGIONS OF WORLD OCEAN

NEUYMIN, G. G., ZEMLYANAYA, L. A., MARTYNOV, O. V. and SOLOV'YEV, M. V.,
Marine Hydrophysical Institute, Ukrainian Academy of Sciences, Sevastopol'

[Abstract] A simple photometer-lucimeter was developed at the Marine Hydro-
physical Institute for measuring the color index of water at 550 and 400 nm.
This instrument makes it possible to carry out continuous measurements while

a ship is proceeding on course or at stations. This article gives a generalization of the data obtained during 1974-1979 on 12 voyages of the "Akademik Vernadskiy" in the Atlantic, Indian, Pacific and Antarctic Oceans, mostly in the Atlantic Ocean (its northern part and the Caribbean and Mediterranean Seas). Both on-course and station data were processed. Continuous records of the color index were made over a distance of about 73 000 nautical miles. A systematic study was made to determine the relationship between the color index and the content of chlorophyll "a" in the upper layer of the sea. A total of 175 pairs of values of the investigated parameters obtained in the open parts of the Atlantic Ocean, Caribbean Sea, Mediterranean Sea and Black Sea were analyzed; the concentration of chlorophyll "a" varied in a wide range (from less than 0.03 to 5 mg·m^{-3}). The regression equation describing the correlation between the color index and the content of chlorophyll "a" in the upper layer of the sea has the form

$$\lg C_{chl} = -0.53 + 0.74 \lg I_{550/440},$$

The distribution of the color index in the northern part of the Atlantic Ocean conforms well to the nature of macroscale oceanic circulation. The entire central part of the ocean is occupied by highly transparent blue waters of the Sargasso Sea, whereas an extensive region between 20 and 25°N has the lowest values of the color index of all those registered in other regions of the world ocean. Accordingly, the chlorophyll concentration here is low --less than 0.05 mg·m^{-3}. The waters of the open ocean for the most part are oligotrophic. The highest color indices are for the waters in the eastern part of the ocean near the shores of Africa, the waters being mesotrophic and eutrophic. In the western part of the ocean there are also regions with high values of the color index adjacent to the northeastern part of South America. Figure 1 is a map of the color index for the central Atlantic; Figures 2, 3 and 4 are corresponding maps for the Indian Ocean, Mediterranean Sea and Black Sea. A table gives estimates of the chlorophyll concentration for several regions of the world. The results of computations using the equation cited above made it possible to evaluate the spatial distribution of chlorophyll "a" and discriminate regions of increased biological productivity. Figures 4, tables 1; references: 9 Russian.
[171-5303]

INTERPRETING SYNOPTIC PHENOMENA IN BALTIC SEA

AYTSAM, A. M. and TALPSEPP, L. A., Institute of Thermophysics and Electrophysics, Estonian Academy of Sciences, Tallinn

[Abstract] The most prolonged experiment in the open part of the Baltic Sea for determining current velocities and temperatures was carried out using six self-contained buoy stations during the period May-August 1980--102 days. The stations were arranged in an "X" over the sloping bottom. This experiment

revealed a strongly expressed synoptic variability in the polygon. At all
stations there were low-frequency variations in the series of horizontal
velocity components, with a dominance of 6- to 8-day variations. In most
cases these variations are also observed in the temperature series. It was
found that for the zonal and meridional velocity components at all stations
in all the velocity series there are peaks with different intensity at periods
of about 7 days. In the series of the meridional component there is also a
14- to 18-day peak not observed in the series of the zonal velocity component.
The 6- to 8-day waves are propagated along the slope (parallel to the isobaths)
or form a small (up to 15°) angle with the isobaths. The lower-frequency
waves are propagated perpendicularly to the isobaths. For variations with
a period of 5.5-7 days the spatial spectrum has a peak which corresponds to
24-km waves propagating in a southwesterly direction. For the 12- to 18-day
variations the spatial spectrum has a peak corresponding to 45-km waves
moving to the west-northwest. The mean currents in the entire polygon were
directed parallel to the isobaths: in the course of the first 70 days in
the direction 200°N and during the remainder of the month in the direction
30°N. The mean velocity for the entire period was about 2-3 $cm \cdot sec^{-1}$. There
was an increase in the amplitudes of the 6- to 8-day variations with an in-
crease in depth. There was also some decrease in amplitudes with increasing
distance from the region with the smallest change in depth. The observed
variations can be explained, as demonstrated in this article, by applying
the theory of unstable topographic waves. Figures 6; references 10:
2 Russian, 8 Western.
[171-5303]

BACKSCATTERING NOISE AND CONTRAST IN ARTIFICIAL UNDERWATER ILLUMINATION

LEVIN, I. M.

[Abstract] A typical scheme for underwater observation with artificial
illumination is examined. A source of stationary radiation with a stipulated
light intensity, uniformly radiating in a quite wide angle (20-40°) and an
optical receiver are situated at a definite distance apart and their directional
diagrams are matched in the observation plane. In computing contrast and the
range of visibility of the object it is necessary to ascertain the intensity
of the backscattering noise or "haze." The problem can be solved by two
methods, but one requires prolonged and unwieldy computations and the second
is suitable only for short optical bases. Accordingly, the author proposes
an approximate method for computing backscattering noise and contrast in the
optical image of an underwater object based on use of a quasi-single approxi-
mation proposed and confirmed by computations by the Monte Carlo method. The
new formulas derived for backscattering noise and contrast are approximate

because of a number of assumptions made. The expressions were checked experimentally to determine the extent to which these assumptions are justified. In situ measurements were made. An object measuring 0.6 x 0.6 m and with a mean reflection coefficient 0.4 was illuminated by underwater light sources with angles of divergence 30 and 75° and was observed with an underwater television camera. The object, camera and light source were on the bottom and the distance between them was changed by a diver. Contrast was measured with an oscillograph and lucimeter. These tests revealed that the derived expressions are satisfactory approximate computations of back-scattering noise and contrast in the image of artificially illuminated under-water objects. The optimum base can be determined for different conditions. Figures 3; references 12: 9 Russian, 3 Western.
[161-5303]

NUMERICAL EXPERIMENTS FOR STUDYING COLLISION OF TWO-DIMENSIONAL ROSSBY SOLITARY WAVES

LARICHEV, V. D. and REZNIK, G. M., Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] A numerical study was made of collisions between two-dimensional Rossby solitary waves in an earlier paper by the authors (DAN, Vol 231, No 5, pp 1077-1078, 1976). The stability of these spatially localized formations relative to disturbances of moderate amplitude has been numerically demon-strated and now an effort has been made to ascertain whether these waves survive during collisions, to determine whether or not they are solitons. The experiment involved solution of the Cauchy problem for the vorticity equation on the β-plane. It was found that in the case of a frontal collision the interaction does not change the characteristics of the colliding waves; the configurations of the waves, their amplitudes and phase velocities are conserved but a phase shift appears which gives the typical picture of the interaction of solitons. The mechanism and pattern of frontal collision of solitary waves in in qualitative agreement with the results obtained by M. Makino, et al. (J. PHYS. SOC. JAPAN, Vol 50, No 3, pp 980-989, 1981); they made similar computations by another numerical scheme and for other wave parameters. It appears that in a frontal collision solitary waves behave as solitons. The collision of waves moving in the same direction differs sub-stantially from a frontal collision and is highly dependent on the wave parameters. The computations show that after a collision only one solitary wave survives (this is the stronger wave; the wave of lesser amplitude is destroyed). However, there are solitary waves which can survive even this type of collision. Still more complex cases are considered. Figures 4; references 5: 2 Russian, 3 Western.
[153-5303]

ICE MEASUREMENTS IN TOPOGRAPHIC SURVEY OF SHELF

CHUPRINA, Ye. P. and BOGDANOV, B. G.

[Abstract] Enterprise No 14 of the Main Administration of Geodesy and
Cartography has accumulated much experience in topographic surveying of the
Arctic Ocean shelf at a scale of 1:25 000. The annual volume of work carried
out by one field party consisting of 8-10 teams is a survey over an area as
great as 1000 km^2. The field season lasts two months between late March and
late May. This article describes some of the preparations made for the coming
field season, such as the readying of instruments, equipment and gear, drawing
up to plans, inspection and repair of transport vehicles. Each team has a
T-100 tractor or GAZ-47 cross-country vehicle, radio equipment and tents or
huts, as well as all that is required for the life of a group of workers in
isolated areas. Information is given on the actual techniques for implement-
ing a survey, such as the geodetic measurements made so that depth measure-
ments can be precisely fixed, including vertical control by the running of
level lines. The most difficult task is the drilling of holes in the ice
which can be as thick as 2 m. Using a thermal drill such a hole can be
drilled in 4-5 minutes, although under very difficult conditions heavier
equipment must be employed. A specially devised sounding lead is used in
making measurements through these holes: a manually operated winch on which
is wound a thin metal cable graduated in meters and decimeters; provision is
also made for taking bottom samples. One sample is taken for each 25 cm^2 of
the compiled map. The thickness of the ice and snow cover is determined with
a measuring rod with centimeter graduations. The field and office processing,
the data integration and mapping procedures are discussed briefly. Experience
has shown that the work procedures described in the article are highly
effective; they are simple, do not require the additional training of
specialists and ensure a high-quality product. A few suggestions for im-
proving the work and product are proposed.
[144-5303]

ACCURACY IN DETERMINING COORDINATES WITH 'POISK-ATM' RADIOGEODETIC SYSTEM

MAYKO, V. P. and IGNATOV, A. M.

[Abstract] The compilation of topographic maps at scales of 1:10 000 and
1:5000 is extremely difficult due to the high requirements on the accuracy of
horizontal control of the ship's position. This is possible with the "Poisk-
ATM" phase heterodyne radiogeodetic system developed by the Yuzhmorgeologiya

Production Association. This transistorized outfit has a range of radiated
frequencies 1.6-2.7 MHz, a stability of the radiated frequencies $\pm 2 \cdot 10^{-6}$; the
required power is 100 W with the current being supplied by 27-V storage
batteries which must be recharged each 10-15 days. It is serviced by a crew
of three men. The unit for measuring and displaying the phase difference is
a so-called electronic digital receiving indicator. A large part of this
article gives a method for determining the different errors involved in use
of this instrument and ways in which it is possible to compensate for these
errors. The instrument and auxiliary devices are installed on a small boat.
The analysis of its performance given by the authors confirms high accuracy
and effectiveness; it ensures an accuracy in measuring coordinates of 7.5 m.
This is an accuracy which is adequate for surveys of the shelf at a scale of
1:10 000 and with modification of procedures and careful work, at a scale of
1:5000. Figures 2; references: 5 Russian.
[144-5303]

RADIOGEODETIC SYSTEMS FOR HORIZONTAL CONTROL OF SHELF SURVEYS

VERNITSKIY, M. I. and GENIKE, A. A.

[Abstract] The presently used procedures for carrying out topographic-
geodetic work on the shelf and in internal water bodies from ships are
described, with emphasis being on the different radiogeodetic systems employed.
One of the important factors used in classifying such systems is the effective
range. The following are the categories into which the described apparatus
fall: 1) long-range (up to 1000 km or more with a measurement accuracy of
several hundred meters); 2) medium range (up to 500 km with a measurement
accuracy from 10 to 30 m); 3) near range (within the limits of direct
visibility with a measurement accuracy from 1 to 5 m). Radio systems in the
first group are used in marine geodesy when carrying out small-scale topo-
graphic-geodetic work (less than 1:500 000). These systems are developed as
global all-weather systems ensuring continuous determination of the horizontal
coordinates of vessels at any points in the world ocean. The same systems
are used both for navigational purposes and for solving problems in marine
geodesy. The low-frequency range of radio waves (from 10 to 300 KHz) is
used. Most systems in the second group are developed primarily as navigational
systems, but they are being used successfully for marine topographic-geodetic
work carried out at scales from 1:200 000 to 1:25 000 (sometimes 1:10 000)
with distances to the shoreline up to several hundred kilometers. These
systems use the range of radio frequencies from 300 KHz to 3 MHz. A dis-
tinguishing characteristic of systems in the third group is that they are
developed as radiogeodetic systems for determining the horizontal coordinates
of vessels when carrying out topographic-geodetic work in coastal regions and
in internal water bodies. These systems are small in size, mass and required

power. They operate in the range of ultrashort waves and in the range of
centimeter radio waves. The required information is transmitted with the use
of a direct ray within the limits of the visibility zone. The effective
range of these systems is several tens of kilometers. Range measurement is
ensured with an error of 0.5-1 m. A table lists the principal technical
specifications of a great number of systems of this type used in determining
horizontal coordinates of vessels. Tables 1.
[144-5303]

DETERMINING COORDINATES OF SEA FLOOR POINTS BY SCANNING-SEARCH SONAR

KAMORNYY, V. M.

[Abstract] The scanning-search sonar [OPG--obzorno-poiskovyy gidrolokator]
was developed at the TsNIIGAiK [Central Scientific Research Institute of
Geodesy, Aerial Mapping and Cartography] for taking photographs of the sea
floor from a moving ship, surveying underwater communication lines and search-
ing for various objects. The sonar photographs make it possible to recognize
pipelines, cable lines, underwater capped oil wells, and similar man-made
objects. This article describes the problems involved in determining the
horizontal coordinates of sea floor points from such photographs. This task
requires the placement of a special reflector on the sea floor with deter-
mination of its plane coordinates by use of the TsNIIGAiK radiogeodetic
system. As the ship moves along its run the plane coordinates of the survey
ship are periodically determined and its compass course is ascertained at
the same time. The data obtained in the survey are adequate for determining
the plane coordinates of the reflector, which are later compared with its
coordinates determined by the radiogeodetic system. The plane coordinates
of sea floor points can be determined by the special sonar by using two
methods--graphic and analytical--which are discussed here in depth. In the
first method the task is ascertaining the position of the object on a survey
sheet at the point of intersection of the bearing to the object with a circle
having a radius equal to the horizontal range from the ship to the point to be
determined or at the point of intersection of two circles whose centers
correspond to the ship's position at the time of registry of the object by
the sonar. In this case horizontal ranges are determined by the sonar. The
second method provides for determining the coordinates of the object by using
polar and linear intersection formulas. It was found that the accuracy in
determining the position of the object by linear intersection is far greater
than when using the polar method. The methods for determining the plane
position of the reflector are based on ascertaining the coordinates on the
basis of two parameters: bearing and horizontal range to the object in the
case of polar intersection and two ranges for linear intersection. The
availability of an excess number of measurements makes it possible to carry

out adjustment by the least squares method and to obtain corrections to the approximate coordinates of sea floor points. The adjustment procedure considerably enhances the level of accuracy in determining coordinates. This review of use of the special sonar indicates that it can be effectively used in carrying out geodetic work on the shelf, in particular, at scales of 1:25 000 or less. Figures 3; references: 6 Russian.
[144-5303]

SURVEY OF FLOOR OF ARCTIC SEAS IN HYDROGRAPHIC WORK

YELISEYEV, B. V., YELISEYEV, V. B. and STEPANOV, V. N.

[Abstract] Navigational charts at different scales and in different projections have been compiled for the seas of the Arctic basin. The subdivisions of the Hydrographic Enterprise have special ships and the necessary technical means for organizing and implementing investigations. During the last decade hydrographic ships of the "Dmitriy Ovtsyn" and "Fedor Matisen" type have been put into service. Most of the hydrographic work is done during the period of the arctic navigation season. The supplies of fuel and water ensure autonomy of navigation of 30 days. Ships of the "Fedor Matisen" type carry the automated complexes "Avtokarta-V," which in combination with the base processing complex "Avtokarta-Kh" perform multisided automation of hydrographic investigations. The article describes the characteristics of these and other shipboard and on-shore instrument complexes. There has recently been a substantial change in the work conditions for hydrographic engineers. Various types of apparatus, instrumentation and equipment are described, the most important of these being radionavigational systems of new types. The outfitting of field teams for surveying the relief of the sea floor from the ice has changed considerably. For example, GAZ-47 vehicles with mechanical drill rigs have been replaced by the more powerful GAZ-71 vehicles outfitted with suspended electric drills, which has considerably facilitated working conditions. Geodetic techniques are described, as are new mechanical sounding leads with electric winches. A new work method for making depth measurements is based on use of a helicopter for reaching inaccessible regions. Office processing techniques have also changed radically in recent years with a substantial improvement in both accuracy and efficiency. Particular attention has been devoted to the automation of the most time-consuming operations. The data processing system used consists of 65 programs ranging from the checking of data to their final representation in the form or original map compilations. Details are given concerning the successive phases of the modernized processing of data. These automated procedures have made it possible to produce about 100 map sheets per year. The productivity of office work has increased by a factor of 1.7 during the last five years.
[144-5303]

GEODETIC AND TOPOGRAPHIC STUDY OF WATER AREAS

KASHIN, L. A.

[Abstract] This overall review of the status of geodetic and topographic
investigations of water areas begins with a summarization of the importance
of such work in the national economy, which is then followed by a brief re-
view of the work accomplished in past decades. Topographic surveys of seas
and major water bodies are now being carried out by units of the Main Ad-
ministration of Geodesy and Cartography not only on sea shelves, but also
in such major lakes as Baykal, Sevan and Ilmen'. In 1981 topographic surveys
were initiated for all the major reservoirs in the country. Topographers
and geodesists have a great work load in connection with the creation of
major reservoirs and canals for shifting great masses of water and changing
the hydrographic network of the country; geological prospecting work is being
carried out on the shelves of many seas, the problems of the Aral and Caspian
Seas are demanding close study and projects are underway for transfer of part
of the runoff of northern rivers into the southern regions of the country.
The task of carrying out topographic surveys of the shelf and water bodies
can be solved successfully only by use of the latest equipment, especially
side-looking sonars, by the introduction of digital modeling on the basis of
use of electronic computers and automated coordinatographs. Sonar surveys
make it possible to automate the process of compilation of topographic maps,
increase work productivity and the quality of work. There is a need for wider
use of surveys and synthesizing apparatus must be used in the processing.
Topographic surveys of water areas must include observations of changes in
water level. Limitation of topographic surveys of water areas to depth
measurements can only result in an impoverishment of maps, which should show
not only bottom relief, but also control points, vegetation cover and bottom
material, industrial and economic features and other structures. The problem
of creating and marking a geodetic network on the bottom of water bodies has
still been poorly developed. Existing methods for the placement of geodetic
marks on the sea floor are time-consuming, expensive and technically complex,
but such fixed marks with known coordinates are needed for carrying out under-
water engineering and geodetic work, for periodic map revision and many other
purposes. Sonars in combination with radiogeodetic systems are the basic
tools for determining geodetic coordinates under such conditions. Soviet
scientists, engineers and technicians feel that they have the competence and
will to solve these and other major problems and can meet the challenge of
their ever-increasing work load. References: 8 Russian.
[144-5303]

TRANSFER OF WIND ENERGY BY SEA WAVES

MAKIN, V. K., Leningrad Division, State Oceanographic Institute

[Abstract] An important problem which has not been completely solved with
respect to the interaction of waves with the wind is a determination of the
energy flux to the waves. Direct experimental measurements of the distribu-
tion of the energy flux from the atmosphere in the wave spectrum are totally
lacking for well-developed waves. Such investigations require determination
of the spectral parameter of wave growth (β) due to interaction with the
atmosphere (the β parameter characterizes the growth of waves due to the
mechanism of Miles instability). Currently available β data are extremely
limited and contradictory. Certain investigators have postulated that the
growth parameter is dependent on fetch, that is, on the position of the con-
sidered harmonic in the wave spectrum. Accordingly, the author sought to
confirm or refute the influence of fetch on the growth parameter with a known
change in the empirical wave spectrum with fetch, as well as the influence
of the form of the empirical spectrum on the growth parameter. The numerical
model of interaction between the wind and the wave spectrum used in these
computations was formulated by the author earlier in OKEANOLOGIYA, Vol 20,
No 2, pp 211-217, 1980. The presented materials convincingly demonstrate
that β is not dependent on the position of the considered wave component in
the spectrum (that is, on fetch). Under ideal wave formation conditions the
growth parameter is therefore only dependent on friction velocity and wave
frequency. It was also found that the form of the spectrum exerts no in-
fluence on the wave growth parameter. Figures 2, tables 1; references 8:
6 Russian, 2 Western.
[133-5303]

INFLUENCE OF OPEN-OCEAN EDDY FORMATIONS ON PASSIVE IMPURITY DIFFUSION

DEMYSHEV, S. G., YEREMEYEV, V. N., IVANOV, L. M. and KNYSH, V. V., Marine
Hydrophysical Institute, Ukrainian Academy of Sciences

[Abstract] The transport of a passive conservative substance in the open
regions of the ocean is reexamined with particular attention to processes of
interaction of the field of concentration of an impurity occupying a limited
region ("spot") with one or more eddy formations. At the initial time of
formation of a spot of impurity of natural or anthropogenic origin its size

is considerably less than the characteristic size of eddy structures. The mechanism of the concentration field will be determined by the dynamics of eddy formations of a synoptic scale. The authors earlier examined the three-dimensional problem of the transport of a passive impurity in the POLYMODE polygon using the apprixmation of a fixed source of impurity, but this is not typical for the open regions of the ocean. Accordingly, the authors formulated and solved the problem of modeling the propagation of an impurity from instantaneous extended sources under the same hydro-dynamic conditions as for the POLYMODE study. The investigation was limited to a plane case. After reviewing the hydrothermodynamic model used and discussing the parameterization of the turbulent movement of the impurity, the numerical methods employed are given and the principal parameters of the problem are formulated. The interaction between the eddy formations and field of concentration of passive impurity is fully described; it is essentially dependent on the initial position of the spot of impurity and its initial size. Among the cases considered are: the instantaneous source is situated at the boundary of the central part of the eddy formation; the source is situated in the central part of the eddy formation; the effect is observed with the interaction of a spot of passive impurity with two eddy formations. Figures 5; references 25: 19 Russian, 6 Western.
[133-5303]

COMPUTING WAVE-COVERED SURFACE FORM DRAG

SIMONOV, V. V., Main Geophysical Observatory

[Abstract] One of the key problems in comprehending the mechanism of generation of wind waves is determination of the momentum flux, averaged for a wave, in the wave-air system which is attributable to the operation of pressure forces. This is called pressure drag or form drag. For determining the pressure field it is necessary to ascertain the structure of the air flow over the wave-covered surface. One of the possible approaches to formulation of this problem was outlined earlier by the author in TR. GGO, No 423, pp 39-51, 1979, and METEOROLOGIYA I GIDROLOGIYA, No 8, pp 13-19, 1980. This new article represents a detailed examination of the unsolved problems evident in these earlier papers. In particular, over a wave-covered surface, in contrast to all other air flow characteristics, pressure is usually an aperiodic component. Pressure can be represented in the form of the sum of the aperiodic part p, which is called external pressure, and the wave component $\tilde{p}$. The article is essentially completely devoted to an evaluation of the relative influence of the aperiodic pressure component on the magnitude of the momentum flux caused by pressure forces with different approaches to its determination. Figures 4; references 21: 10 Russian, 11 Western.
[133-5303]

GEOGRAPHICAL DISTRIBUTION OF MESOSCALE TOPOGRAPHIC EDDIES IN EASTERN NORTH
ATLANTIC

KORT, V. G., corresponding member, USSR Academy of Sciences, Institute of
Oceanology imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] During the 31st voyage of the "Akademik Kurchatov" eddy field
structure was investigated by measurements of the vertical distribution of
temperature to a depth of 500 m while the ship was proceeding on course
along 15 transoceanic runs with a total extent of 16 500 km. A map
accompanying the text shows the location of these runs. In this region
internal waves of a semidiurnal period constitute considerable interference
in detecting the spatial structure of the eddy field. A total of 21 eddy
formations were detected; their position is shown in Fig. 1 and their
principal characteristics are given in a table. The position of all these
eddy formations correlates closely with bottom topography. The eddies are
in regions of bottom rises. Thus, they appear to have a topogenic character.
Mesoscale eddies are not found in regions of great ocean depths and even
bottom relief. The density of "packing" of the mesoscale eddies is essentially
different, depending on the nature of bottom relief. In regions of individual
banks it is more common to observe individual eddies or pairs of eddy for-
mations. Trains of eddies are observed in regions of strongly dissected
relief. An important parameter of the eddies is the slope of their axes;
there is a close correlation between the direction of axis slope and the
direction of eddy movement. The velocity of movement of these eddies is
5-9 km/day. There is a definite correlation between eddy structure and
intensity of these formations. Figures 1; tables 1; references: 1 Russian.
[169-5303]

VERTICAL STRUCTURE OF THIN OCEAN SURFACE LAYER DURING WEAK WIND

SOLOV'YEV, A. V., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] A study was made of the formation of the surface quasihomogeneous
layer (SQL) and the possibilities of describing this phenomenon with a one-
dimensional integral model were investigated. The experiments were carried
out during the 18th voyage of the "Akademik Vernadskiy" using a so-called
floating-up probe which made it possible to obtain the vertical distributions

of temperature and conductivity with a millimeter spatial resolution. The
low inertia of the temperature sensor and the rate of movement of the probe
1 m/sec made possible a reliable investigation of elements of the thermal
structure of the decimeter surface layer forming due to daytime heating.
Probe measurements were accompanied by a wide range of shipboard radiation
and meteorological observations needed for evaluating heat and momentum fluxes
at the ocean-atmosphere discontinuity. It was found that the thickness of
the SQL at the midday hours under stable meteorological and radiation condi-
tions virtually does not change in comparison with the morning and evening.
The integral model proposed is similar to that used in modeling of the
seasonal quasihomogeneous layer, but differs in that it takes into account
the volumetric absorption of solar radiation in the thin surface layer. Such
an integral model, with the volumetric absorption of solar radiation taken
into account, was used by the author earlier (IZV. AN SSSR: FAO, Vol 15,
No 7, pp 750-757, 1979) in computing the depth of the SQL under calm condi-
tions, rather than when there is a wind. Experimental and theoretical values
for depth of the mixing layer are compared for four different regions in the
Atlantic Ocean. Figures 4; references 15: 13 Russian, 2 Western.
[193-5303]

QUASISTATIONARY GEOSTROPHIC MOTION OF SLIGHTLY STRATIFIED FLUID IN OCEAN
WITH RANDOM BOTTOM RELIEF

KOZLOV, V. F., Pacific Ocean Oceanological Institute, USSR Academy of Sciences

[Abstract] In a closely related earlier study ("Geostrophic Motion of a
Stratified Fluid Over an Uneven Bottom," IZV. AN SSSR: FAO, Vol 13, No 9,
pp 961-970, 1977), in a geostrophic approximation on the beta plane, a study
was made of the stationary problem of macroscale motion of an incompressible
inhomogeneous fluid in an infinite horizontal layer with random topography.
Proceeding on the basis of their earlier work, the already developed approach
is generalized for the case of a nonstationary problem when the advancing
flow can change with time. A solution is obtained in the form of an
asymptotic expansion of some small parameter entering into the boundary con-
ditions (it is assumed that the ratio of the square of the Burger number to
the Rossby number is small). An asymptotic solution is obtained for the
problem of the effect of a random disturbance of bottom relief on the zonal
nonstationary flow without shear. As a first approximation it is shown that
the pressure field is dependent on time only parametrically through the
barotropic component of motion; the nonstationary character of the baroclinic
component is manifested only in small second-order terms. An explicit ex-
pression is derived for the pressure field which is suitable in the case of
random bottom relief and which makes it possible to investigate the influence

of stratification and a change in the velocity of the main flow. All this
makes possible a qualitative analysis of the influence of isolated bottom
relief forms both for individual components and all taken together.
References 7: 5 Russian, 2 Western.
[193-5303]

METHOD FOR MODELING WAVE EXCITATION PROCESS IN FLUID BY LOW-PRESSURE REGIONS

KALINICHENKO, V. A., NESTEROV, S. V., NIKITIN, N. L. and SEKERZH-ZEN'KOVICH,
S. Ya., Institute of Mechanical Problems, USSR Academy of Sciences

[Abstract] In earlier laboratory experiments for the excitation of waves in
a fluid by low-pressure regions such regions were created by the evacuation
of air from tubes whose open ends were situated almost flush to the free
surface. This article describes a fundamentally new and much more convenient
method for achieving this goal. The basis for the method is use of high-
strength electric fields. An electrode, connected to one of the poles of a
source of high d-c voltage, is placed in a conducting fluid and the electrode
connected to the other pole is situated over its free surface. An electric
field arises between the second electrode and the conducting fluid. The
ponderomotive forces of this field draw the surface of the fluid into the
region of the maximum field, which is equivalent to the creation of a region
of reduced pressure over the free surface. The size and shape of the de-
pression region can be varied as a function of size and shape of the second
electrode. The depth of the depression can be regulated by a change in the
potential difference between the electrodes or the distance from the second
electrode to the discontinuity. If a layer of dielectric with the dielectric
constant $\gamma > 1$ is poured atop the conducting fluid the depression is increased
by a factor of γ. An a-c voltage source can also be used, making it possible
to simulate the effect of nonstationary sources of reduced pressure. The re-
sults of this modeling are given for several experimental variants. Not only
is the method simple, making it possible to simulate depressions at the free
surface and at the discontinuity of two fluids with the excitation of internal
waves, but nonstationary pressure fields can be simulated as well. Figures
5; references 4: 3 Russian, 1 Western.
[151-5303]

GENERATION OF DIRECTED TSUNAMI WAVE IN COASTAL ZONE

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Sciences

[Abstract] The generation of a directed tsunami wave in the coastal zone is
examined theoretically with special reference to the catastrophic tsunami
wave generated by the Chilean earthquake of May 1960. During that event a
directed, slightly attenuating tsunami wave was formed in a direction per-
pendicular to the coast of Chile. The formation of such an acutely directed
tsunami wave is evidently associated with its generation in the coastal zone
where the fundamental mechanism of wave generation is horizontal motions of
the bottom and interaction between the direct and reflected waves. The
article represents an attempt at a theoretical explanation of the observed
process. The features of tsunami generation on the continental slope are
modeled by an arbitrary distribution of mass force stipulated in time and
space. The wave profile is computed for the case of a single tsunami-
generating tsunami and its amplitude is estimated. The results of these
computations are compared with the actual data obtained for the Chilean
tsunami. Figures 4; references 5: 4 Russian, 1 Western.
[151-5303]

NUMERICAL EXPERIMENTS ON SEASONAL EVOLUTION OF CARBON CYCLE IN OCEAN

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Sciences

[Abstract] The carbon cycle in the ocean is described within the framework
of a simple "box" model. The ocean is considered to consist of two regions:
a region of formation of cold deep waters and the remaining part of the ocean,
within which the entry of cold deep waters from the regions of their sources
is compensated by upwelling. In this region two layers are defined: upper
quasihomogeneous layer and deep layer and these are regarded together with
the region of formation of cold deep waters as a system of interrelated boxes.
A closed system of equations is written which makes it possible to reproduce
the seasonal evolution of temperature and the carbon concentration in each of
the three considered boxes, the thickness of the upper quasihomogeneous layer,
the concentration is dissolved carbon dioxide, bicarbonate and carbonate ions
and hydrogen ions, gas exchange with the atmosphere and the exchange of heat

and carbon between the upper quasihomogeneous layer and the deep layer of the ocean. The initial data used for determining the enumerated characteristics was information on the heat flow at the ocean surface, CO_2 partial pressure in the atmosphere, dynamic wind velocity, intensity of the source of cold deep waters and the ratio of the areas of the region of upwelling and the region of formation of cold deep waters. The results of the computations reproduce the principal features of the seasonal variability of the thermal regime and the carbon cycle in the ocean observed under natural conditions, such as: phase coincidence of the moments of onset of the maximum heat flow at the ocean surface and the minimum thickness of the upper quasihomogeneous layer; lag in the temperature maximum in the upper quasihomogeneous layer relative to the maximum surface heat flow; virtually complete absence of seasonal fluctuations of temperature and carbon dioxide concentration in the deep layer; increase in gas exchange in the autumn-winter period and its decrease in summer; change in the course of the year in the direction of gas exchange in the temperate and low latitudes (upwelling region) and a constancy of CO_2 absorption by the ocean in the high latitudes (region of formation of cold deep waters). The results of numerical experiments are given. Figures 3, tables 1; references 27: 14 Russian, 13 Western.
[151-5303]

AUTOOSCILLATIONS IN FOUR-EDDY SYSTEM

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[Abstract] Autooscillations in eddy systems can develop under the influence of thermal excitation, but in addition to forced convection, eddy currents can be created by magnetohydrodynamic excitation, making it possible to study purely dynamic effects. The phenomenon of regular autooscillations in eddy systems excited by this method was described by M. Z. Gak in IZV. AN SSSR: FAO, Vol 17, No 2, pp 201-205, 1981. This article constitutes a theoretical investigation of the motions observed by Gak, making it possible to predict some new effects. Instead of the oval cell employed earlier, this study was made in a rectangular region. After examining positions of equilibrium, stability of stationary currents and periodic regimes, the author analyzes a two-dimensional current with allowance for the shear of the horizontal velocity component due to bottom friction. Applying the equations of motion of an incompressible fluid, in the thin layer approximation, using the Galerkin method, it was possible to construct an eight-mode model which describes the stationary flow of a fluid and also autooscillation regimes. It is demonstrated that in such a system there are two possible autooscillation mechanisms, bottom friction being the governing factor. The stability of the autooscillation and stationary regimes is a function of the intensity of the magneto-hydrodynamic excitation, the degree of bottom friction and cell length. Figures 4; references 11: 8 Russian, 3 Western.
[151-5303]

UDC 551.24(265)

DEEP STRUCTURE OF TRENCHES IN SOUTHERN PHILIPPINE SEA

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Eastern Scientific Center, USSR Academy of Sciences, Khabarovsk

[Abstract] A Pacific Ocean Geophysical Expedition operated in the southern
part of the Philippine Sea in 1978-1979 using the two ships "Morskoy Geofizik"
and "Fedor Matisen" with attention concentrated on the Yap island system and
a small polygon in the neighborhood of the Philippine trench. The results
considerably supplemented the data obtained on the 17th voyage of the "Dmitriy
Mendeleyev" and the 54th voyage of the "Vityaz'." The investigated area is
described in detail (Fig. 1 is a bathymetric chart of the Yap island system;
Fig. 3 is a map of the magnetic field for this same area). The text outlines
the characteristics of the anomalous gravity and magnetic fields, the results
of profiling by the continuous seismic profiling and refracted waves methods
and morphological features. The anomalous gravity field in the Faye reduction
reflects a block structure of the earth's crust, clearly manifested in bottom
relief. The maximum field values are associated with underwater rises and
islands and the minimum values with the axial part of the trench. The upper
part of the crust in the neighborhood of the Yap trench is without sediments
and therefore the map of Bouguer anomalies reflects primarily the behavior of
the bottom of the crust or some other deep discontinuity. The relationship
between bottom relief and relief of the M discontinuity along the strike of
the trench suggest the presence of transverse faults permeating the entire
crust. Analysis of the anomalous magnetic field indicates a block rather than
a linear zonality. The new data considerably alter some data and concepts
given in the collective work GEOLOGIYA DNA FILIPPINSKOGO MORYA (Geology of
the Philippine Sea Floor) (Moscow, Nauka, 1980). It is clear that the Yap
trench penetrates only the upper part of the modern crust. Figures 3;
references 12: 7 Russian, 5 Western.
[180-5303]

UDC 528.472.528.7

ACCURACY OF DETAILED SURVEY OF BOTTOM RELIEF USING AERIAL PHOTOGRAPHY

ZUBCHENKO, E. S. and KONDYURIN, V. D.

[Abstract] This is an evaluation of a method proposed earlier by the authors
("Photometric Method for Determining Depths From Aerial Photograph," GEODEZIYA
I KARTOGRAFIYA, No 11, pp 47-49, 1981). Practical work was done on the shelf

during 1977-1979. The method involves an aerial photographic survey, necessary geodetic work for horizontal control and depth measurements. The aerial negatives were photometrically measured along lines ensuring the necessary detail in survey of bottom relief. Accuracy in surveying bottom relief was evaluated by comparing the depths determined in a control sector by the photometric method and those obtained with an echo sounder. In the control sector, measuring 1.5 x 1.5 km, depth measurements were supplemented by a bottom material survey and hydrooptical measurements. The aerial survey was made at a scale of 1:20 000 with a standard aerial camera and film and light filter ensuring a survey in the spectral region 490-550 nm. The mean square error in measuring depths with the echo sounder was 0.1 m. The horizontal position of the measured depths was determined with a mean square error 1-3 m. Bottom samples were taken with a small dredge and corer at 20 points. Spectral reflectivity of bottom materials was ascertained by spectrophotometer measurements of the spectral brightness coefficients of dried bottom materials. Hydrooptical measurements were made to determine the indices of light attenuation at each horizon. Depths were determined from the aerial photograph along photometric lines run each 1 cm along directions perpendicular to the shoreline. The results of depth computations were plotted on transparent sheets at 1:10 000. As a comparison this sheet is laid over a chart with depths plotted on the basis of echo soundings. The discrepancy in the range 1-10 m was 0.25 m. The greatest depth discrepancies were in places with a strongly expressed nonuniformity of the spectral reflectivity characteristics of bottom materials. This can account for errors as much as 1 m in the depth range 0-10 m. Supplementary field work should be carried out. Otherwise the proposed method for a detailed survey of bottom relief ensures the required accuracy. Figures 1, tables 2.
[196-5303]

STEREOPHOTOGRAMMETRIC APPARATUS FOR MAPPING SEA FLOOR

SINYAKOVA, T. G. and SHAPOSHNIKOV, A. I.

[Abstract] The GSFU-1 stereophotogrammetric apparatus was developed for surveying the sea floor over considerable areas and at depths to 6 km for mapping purposes and continuous photography of underwater objects of considerable extent. Such a survey is made from underwater research vehicles. At each moment during the exposure it is possible to obtain navigational and hydrological data necessary for computing the quantitative characteristics of sea bottom relief and underwater objects. The GSFU-1 consists of a frame to which two housings are attached, the cameras within them being oriented in such a way that their optical axes are parallel to one another and perpendicular to the base; the distance between the optical axes is 1500+1 mm. A command instrument is located inside the vehicle's hull and is connected by cables to the camera mechanism, making remote control possible. The camera uses 35-mm film, the frames measuring 24 x 24 mm; pertinent data are imprinted in the

margin. The cameras have specially designed "Akvar-1" wide-angle objectives; the focal length of the objective in the water is 17.2 mm and the relative aperture is 1:3.4; the field of view is 90°. The objective ensures a survey of the bottom with an individual photograph covering from 2 to 102 m^2 with distances from the bottom of 2 to 8 m respectively. The film is 35 m long, enough for 900 sterepairs. The outfit can take either single photgraphs or be operated automatically with intervals of 0.5-17.5 sec. The stereopairs are processed with standard stereophotogrammetric equipment. Ordinary stereophotogrammetric formulas are used, transformed to make allowance for the propagation of light rays in water. A computer is used in analyzing the many input data required in further analysis. The images of bottom relief are highly accurate and detailed and can be used in mapping at 1:250 or larger. Figures 3.
[196-5303]

INVESTIGATING HYDROPHYSICAL PROCESSES IN SEA COASTAL ZONE

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[Abstract] The article reports on investigations of mesoscale processes in the sea shelf zone. An in situ experiment was carried out for studying the current velocity field, stratification of water masses and the effect of meteorological factors on them. During a multiday station specialists aboard an anchored ship measured the continuous vertical profiles of temperature and salinity, determined current velocity at different horizons and determined wind velocity and the flux of total solar radiation. These data were used in analyzing fluctuations of these characteristics in the range of periods 0.66-20 hours. Measurements of the distribution of temperature and conductivity were made by vertical sounding, conductivity was determined by the conducto-metric method, current velocity was ascertained at discrete horizons using a nonstandard blade-type current meter and the wave spectrum was found with a string wave recorder. Figure 1 shows the vertical distribution of temperature, mean current velocity and nominal density; Fig 2.--vertical distribution of the dispersion of temperature and current velocity, Väisälä-Brunt and Richard-son numbers; Fig. 3--spectra of temperature fluctuations at a series of horizons; Fig. 4--spectra of current velocity fluctuations at different horizons and spectrum of fluctuations of depth of thermocline "core"; Fig. 5--spectra of fluctuations of wind velocity components normal and parallel to shore. The analysis of all these materials indicated that under definite conditions the principal role in the formation of the dynamic processes and the thermal processes related to them can be played by the wind field. The momentum flux imparted from the wind causes fluctuations of the current velocity field and penetrating in depth, causes oscillations of the jump layer. This is in turn

reflected in the temperature spectra. Thus, it is possible to predict the variability of hydrological fields in the coastal zone on the basis of measurements of the wind field. Figures 5; references: 6 Russian.
[154-5303]

BOTTOM DEPOSITS, PALEGRAPHIC FEATURES AND GEOLOGICAL HISTORY OF ARCTIC OCEAN

BELOV, N. A., RUSANOV, V. P. and OGORODNIKOV, V. I.

[Abstract] The geological history of the Arctic Ocean is being reconstructed on the basis of a lithological and geochemical study of a great many cores of bottom deposits recovered on expeditions of the Arctic and Antarctic Scientific Research Institute in the Arctic and North European Basins. The analyzed and integrated data have been incorporated into a full-page stratigraphic breakdown of bottom deposits. The diagram was constructed using data from 600 cores. The most valuable cores were obtained from the drifting station "SP-7" (1958-1959); core length varied from 200 to 420 cm. All the morphostructual elements of the Arctic Basin are represented by cores collected by numerous expeditions. In the North European Basin similar materials (more than 200 cores, some 600 cm in length) were collected by scientists aboard the "Professor Vize," "Professor Zubov" and other research vessels. The study of the mineralogical composition of the cores made possible a stratigraphic breakdown of the Quaternary deposits. The investigations included detailed lithological, macro- and microscopic investigations of moist and dry bottom deposits, analysis of the granulometric composition of the samples and the presence of coarse fragments, geochemical study of samples for determining the content of carbonates, iron, manganese and organic carbon, analysis of the mineral composition of samples and study of North Atlantic microfauna presemt in the deposits. The great volume of data was used in constructing generalized sections of bottom deposits in abyssal depressions. The article generalizes all these materials for individual sectors of the basins. Figures 1, tables 1; references 6: 5 Russian, 1 Western.
[168-5303]

CHARACTERISTICS OF FORMING OF CYCLONIC MEANDERS AND EDDIES IN SUBARCTIC FRONT ZONE (FROM ARTIFICIAL EARTH SATELLITE DATA)

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[Abstract] Infrared space photographs of the northwestern Pacific Ocean reveal narrow intrusions of warm waters to the north of the Oyashio front and cold waters to the south of it. The author has investigated the structure and evolution of cold water intrusions into the frontal zone. The data used were from the NOAA-4 satellite and shipboard observations made under the program for studying the Kuroshio in 1976. In the subarctic front zone cyclonic meanders of currents are narrower and eddies are smaller than anti-cyclonic meanders and eddies. On the IR images intrusions of subarctic waters into the frontal zone resemble jets of turbid waters in coastal regions. Their western boundary is usually clear and relatively smooth, indicating that the warm and cold waters are moving at approximately the same velocity. The eastern boundary has a blurred brightness and uneven configuration, evidence of considerable horizontal current velocity shears. The article examines an example of interpretation of this phenomenon from a map compiled from IR photographs supplemented by hydrological measurements to a depth of 1000 m. Figure 1 is a map of the investigated area. The good agreement between the results of interpretation of IR images of the ocean surface and the results obtained by the dynamic method for computing currents reveals that all the flows and eddies defined on the basis of this study are quasi-geostrophic and that by using IR photographs it is possible to trace the process of formation of a cold inflow or an eddy. The joint analysis of satellite and shipboard data shows that cyclonic meanders of the northern boundary current in the subarctic front zone can be asymmetric: only part of the subarctic waters is included in the cyclonic rotation; the remaining mass retains a southerly direction of movement and the advection of cold waters into the frontal zone occurs not only due to the isolation of eddies with a cold nucleus, but also as a result of penetration of cold jets into the main Kuroshio flow. The evolution of intrusions of cold waters into the frontal zone gives basis for assuming that the energy transfer of the eddies is in an easterly direction, whereas the eddies themselves move in a westerly direction (with a southerly or northerly component). Figures 3; references 10: 5 Russian, 5 Western.
[178-5303]

NEW DATA ON WATER EXCHANGE IN YUCATAN CHANNEL

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[Abstract] A hydrological survey was made across Yucatan Channel from Cuba
to the Mexican coast in April 1981 during the first voyage of the scientific
research ship "Akademik Mstislav Keldysh." Seven bathometric stations and
three autonomous buoy stations were occupied. As a result of this survey
it was possible to confirm that the Yucatan Current has a two-nucleus
structure in the surface and subsurface layers of Yucatan Channel. This
structure is seen clearly in the distribution of the characteristics of
water masses on the assumption that the western jet has its origin in the
eastern straits of the Caribbean Sea and the eastern jet has its origin in
the northern straits. It was found that the distribution of hydrological
characteristics in Yucatan Channel is quasistable with time and reflects the
dynamic state of waters. The Yucatan Current is characterized by a maximum
oxygen content at the surface and a minimum content at the lower boundary of
the main flow. The vertical stratification of waters in Yucatan Channel is
stable. The water masses in the channel are subtropical subsurface waters
and Antarctic intermediate waters which are identified as the nuclei of the
salinity maximum and minimum respectively. The layer of the main pycnocline
(main thermocline) lies between these water masses. There is a two-layer
circulation in Yucatan Channel: the Yucatan Current and Yucatan Countercurrent,
whose upper boundary is at a depth of about 700 m. In the deep part of the
channel there are horizontally developed currents which cause free water
exchange of bottom waters between the Caribbean Sea and the Gulf of Mexico.
Figures 1, tables 1; references 11: 7 Russian, 4 Western.
[189-5303]

SLOW SPREADING OF VISCOUS FLUID ALONG HORIZONTAL SURFACE

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[Abstract] A study was made of the relatively simple problem of the spreading
of a homogeneous viscous fluid along a horizontal surface. The situation
examined is characterized by two small parameters--relative spot thickness

σ = H/R and Froude number F = U/$\sqrt{gH}$, where H is spot thickness, R is its radius, U is the characteristic velocity and g is gravity. Expansion in these parameters makes it possible to reduce the Navier-Stokes equations to one nonlinear equation for the rise h of the free surface. Having geophysical applications in mind, regimes are considered in which the influence of surface tension is small. If at the center of an axisymmetric spot there is a constant inflow of fluid with the intensity Q, it is possible to find a self-similar solution of the shortened fundamental equation

$$R = AQ^{3/8}(\tfrac{g}{\nu})^{1/8}t^{1/2}, \tag{I}$$

where A is a dimensionless universal constant; A = 0.62. The expression (I) was checked experimentally with a change in the decisive parameters Q, ν, σ and spot radius R in a wide range. An experimental apparatus for checking this expression is described. In all the experiments the spot was virtually axisymmetric. (Impairments of spot form occurred only in the case of a very low viscosity of the solution). The dependence of spot radius on time in each experiment was approximated by the dependence $R \sim t^n$ (n assumed values from 0.40 to 0.58 in the experiments). The dependence of R and Q and ν was investigated. The results of 8 experiments with ν = 0.42$\pm$0.02 cm^2/sec and different Q values are given. The experimental dependence is approximated by the function $R \sim Q^m$, m = 0.38 with a correlation coefficient r = 0.998; the experimental dependence of R on ν is in agreement with the theoretical value $R \sim \nu^{-1/8}$. Both of these experimental values agree well with theory. In a wide range of changes in Q, ν, σ, t, R there is a universal dependence of R on r; this dependence is described well by formula (I), but A_{exp} = 0.65. Figures 3; references 8: 7 Russian, 1 Western.
[189-5303]

PROGRESS REPORT ON KOLA SUPERDEEP HOLE

[Article by Boris Konovalov, "Izvestiya" scientific reviewer]

[Text] Until recently the earth's deep layers have been explored by indirect methods -- from the planet's surface. The Kola borehole has become the deepest underground laboratory in the world, where investigations are made directly, without "middlemen."

<p align="center">***</p>

When you come upon the building of the superdeep drill rig amidst the desert transpolar hills it is completely unexpected. Here on the Kola Peninsula, not far from the Soviet-Norwegian border, specialists are carrying out a unique experiment. Usually the depth of drilled boreholes on our planet does not exceed 6-7 km. When the 9-km level (9159 and 9583 m) was exceeded in the United States, this was an extraordinary event. The Kola borehole exceeded the American record: it extended more than 11 000 m from the earth's surface!

Outwardly the drill rig does not make a grandiose impression. But inwardly you sense something like quivering. The heavy-duty pipes entend up in the air. The point where they join is difficult to distinguish. The pipes extend into the depths of the earth. They are assembled, screwed together from segments each with a length of 37 m. The assembly is one of the most important aspects of the work: the "trunk" of pipes is heated, steel retainers are screwed on the ends and by means of these the segments are connected. They are made of light alloy metals. Each segment is carefully checked using defectoscopic apparatus: to see if there are any blisters or fractures. Otherwise the entire multikilometer monster can snap.

The drilling proceeds slowly. In the case of commercial drilling it is another matter: how to get as quickly as possible to the ore body, the gas- or petroleum-bearing stratum. But the task of the Kola borehole is research. For this reason here they drill tens of meters, remove a rock core and on to the laboratory.

The pipe is drawn from the depth of the borehole by a 1 1/2-m block and tackle assembly, the size of the wheel in the gigantic BelAZ apparatus. The segments are again unscrewed. This is done with a mechanical arm; it again connects the segments to the lowering-raising mechanism, which sets them in the "holders"

on either side of the drill rig. In the last elongated link there is a turbo-drill with a four-cutter toothed head: it is this which gnaws into the depths of the earth.

This drill rig is an instrument of knowledge. The tool is complex and unique. Suffice it to mention that there are more than a hundred electrical machines here. Their total power is entirely sufficient for supplying power to a small city. The unique drill rig was created at "Uralmash."

For the first time scientists have obtained the possibility of becoming acquainted with the earth's interior at great depths by direct geological methods and to process extracted samples of rocks by means of an arsenal of laboratory research apparatus. Now in this field of science data are available which have been obtained by indirect methods from the earth's surface, for example, by electromagnetic sounding, by study of the nature of propagation of natural and artificially induced seismic waves or investigation of the earth's gravity field.

The Kola borehole is being drilled in the so-called Baltic crystalline shield. It consists of the most ancient rocks developing in the earliest stages of formation of the earth's crust -- the Archean and Proterozoic. Here it is possible to investigate rocks whose age is from 1.5 to 3 billion years.

Differently colored cylinders of rocks from white to charcoal-black, extracted from the Kola depths and placed now in the core storeroom -- a sort of "archives" of rocks -- have made it necessary to reexamine many existing concepts. It was assumed, for example, that nickel ores must be situated near the surface -- not deeper than 700 m. But at a depth of 1600-1800 m the hole penetrated an ore body with a commercial content of copper and nickel.

The upper layer of volcanic rocks with an age of 1500-1700 million years was far thicker than assumed. It was found that the boundary of transition of rocks to more ancient rocks -- Archean with an age of not less than 2 billion years -- is at a depth of 4500-4700 m, but in actuality it was at a depth of 6800 m.

It was found that it is impossible to break the earth's crust down distinctly into granite and basalt layers: in the neighborhood of the Kola borehole by geophysical methods this boundary was established at a depth of 7 km. But basalts did not appear even at the 11-km level.

An increase of temperature with depth was also unexpected. It was assumed that in the Baltic shield the temperature will be increased by approximately one degree each hundred meters. At a depth of 15 km it should be about 140 degrees. The first three kilometers went according to computations. But then one degree was added each 40 m. At 11 km the instruments read more than 180°! This means that the shields of our planet are not dead, cooling formations; geophysical processes in this region of the earth were slowed only at the surface itself.

At a depth of 11 000 m the pressure of a hydrostatic column of solution in the borehole is about 1200 atm. It is assumed that the natural pressure of the rocks here is about 3000 atm. But even such a pressure did not press the rocks

together. In the borehole there are zones of strong fissuring; inflows of aqueous solutions and gases containing bromine, iodine, heavy metals, helium, hydrogen, nitrogen and methane are registered. The earth breathes. This makes it necessary to take a new look at the processes of formation of hydrothermal ore deposits, the problem of the origin of petroleum.

It is interesting that the drilling transpires in a shaft which does not have the usual metal casings. These protected only the upper two kilometers of the Kola borehole. And the shaft goes on and on with the same diameter (again in contrast to ordinary boreholes, which seemingly are drilled in steps: their diameter decreases with depth).

Each new meter increases the difficulties "in a geometrical progression." For example, ideal conditions for curvature existed at great depths. In 2-km boreholes a deviation from the vertical of a whole 40° is allowed. But in this case it is impossible to allow the curvature of the borehole to exceed one degree per kilometer. Otherwise this would cause an increased wear and tear on the pipes or even their snapping. There are many difficulties, but the experience which is being gained here will be truly invaluable for the future.

The Kola borehole is only part of the Soviet program of superdeep drilling. At present near Saatly village in Azerbaijan similar drilling is being carried on in the deep layers around the Caspian Sea. There they have already drilled about 8 km in relatively recent sedimentary rocks -- their age does not exceed 600 million years. In the future plans call for drilling superdeep holes in the neighborhood of the metal-ore Urals, the Tyumen' petroleum- and gas-bearing region and in other geologically interesting places.

Superdeep drilling, in combination with aerial, space, geophysical and geochemical investigations, reconnaissance and exploration work on the land and sea, will ensure accelerated geological study of the territory and an increase in the proven reserves of mineral-raw material resources in the USSR.

EFFECT OF INTERLAYERS WITH ANOMALOUS SEISMIC WAVE VELOCITY ON IMAGE OF OBJECTS

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[Abstract] The following approach has been formulated for determining the distorting influence of a complex medium on the image of a seismic object. First, a test object is selected for which it is convenient to characterize possible changes in the image of the object and a set of some elementary distorting factors is defined. Then the influence of these factors on the image is clarified. This approach is useful if the conclusions concerning the test object can be applied to a considerable range of variants of practical models typical for seismics. The same should apply to a set of distorting factors. For example, if the conclusions are simple and graphic for each of the elements in the set and a complex distorting medium can be interpreted as the consequent effect of the individual elements, with the total effect being equal to the sum of the elementary effects, it becomes possible to solve a more complex problem. In describing distortions it is necessary that three main factors be taken into account: change in configuration, spatial position and level (brightness) of the object image. The test objects used are a cylinder in a two-dimensional model and a sphere in a three dimensional model. Distorting elements (regions with an anomalous velocity of seismic waves) are rather easily taken into account. Interlayers can be represented as a set of the following characteristic elements: plane-parallel plate, wedge and lens (convex or concave). It is shown that lenticular interlayers with an anomalous speed of sound cause an apparent change in the configuration of imbedded objects, wedgelike interlayers cause an apparent change in the angular position of an object and plane-parallel plates cause an apparent change in depth. The expressions given by the author make possible a quantitative evaluation of the introduced distortions if the horizontal dimensions of the interlayers are not less than the dimensions of the observation profile. However, if the interlayers are small in comparison with the radius of the Fresnel zones, a scattering effect is generated which in the case of a certain thickness leads to a loss of transparency. Figures 5; references: 1 Russian.
[138-5303]

KINEMATIC ASPECT OF CONTINUATION OF SEISMIC WAVE FIELDS

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[Abstract] The article was written in connection with the introduction of a new class of inverse problem in seismics, so-called inverse kinematic problems for inverse continuation of wave fields. Accordingly, a careful analysis of made of this concept of inverse continuation. All this is of interest due to the wide-spread application of the migration, D-transformation and other algorithms. The study was made in the search for improved visualization of the geometry of reflecting objects. Important concepts are introduced: kinematically equivalent (K-equivalent) differential operator and K-equivalent field continuation operator. Using these it is possible to validate not only the possibility of replacing the initial Lamé equation by a simpler equation (such as the wave equation), but also the existence of an infinite set of continuation operators ensuring the construction of a wave field having the necessary properties. The visualization of the objects is interpreted as a dynamic analogue of the Yu. V. Riznichenko time field method. It is shown that a whole family of K-equivalent field continuation operators can be used for visualization purposes, this not only justifying the replacement of the Lamé equation, but also the replacement of precise continuation formulas by their ray or even rougher approximations. Figures 1; references 8: 7 Russian, 1 Western.
[138-5303]

PREDICTION OF GEOLOGICAL SECTION OF UPPER PALEOZOIC DEPOSITS UNDER WEST SIBERIAN PLATFORM CONDITIONS ON BASIS OF SEISMIC WAVE DYNAMIC CHARACTERISTICS

RUDNITSKAYA, D. I., BERILKO, V. I., KONDRASHOV, V. A. and BELOV, R. V., Siberian Scientific Research Institute of Geology, Geophysics and Mineral Raw Materials

[Abstract] On the West Siberian Platform many petroleum and gas deposits are associated with the zones of contact between sedimentary deposits and the Pre-Jurassic basement, as well as zones with an abrupt change in the collector properties of rocks in the upper part of the Pre-Jurassic basement related to an alternation of blocks with different lithological composition of the

rocks. In this article particular attention is given to the prospects for discovering new petroleum deposits in Tomskaya Oblast in the Severo-Ostaninskaya area (Fig. 1 is a map of the distribution of tectonic and lithological elements in this area). The work which has been done in this area is reviewed. Among the new methods which can cast new light on its oil- and gas-producing potential is the visualization of the results of processing in the form of two-dimensional fields. At the Siberian Scientific Research Institute of Geology, Geophysics and Mineral Raw Materials specialists have developed the ASAN system for automatic analysis of wave field parameters. It is designed for performing the following operations: computation (with any stipulated density) of the network of initial evaluations of seismic parameters (energy, signal amplitude, coherence, signal-to-noise ratio, effective velocity); statistical processing of the data masses; construction of two-dimensional fields of parameters with a stipulated degree of smoothing. In the studied area the ASAN system was used in processing common deep point method data along a network of profiles intersecting the central block in meridional and latitudinal directions. The use of this sytem made it possible to obtain the dynamic characteristics of the seismic record for mapping dis-locations in accordance with their proposed physical-mechanical model and also for evaluating the quality of the collectors in the contact zone of Palezoic deposits and the localization of sectors with improved collector properties. The experience reported in this article is suggestive of broad possibilities of the dynamic interpretation method in the search for and exploration of complexly structured petroleum deposits and the need also for continued improvement. Figures 2; references: 5 Russian.
[138-5303]

METHOD AND RESULTS OF SEISMIC PROBING OF LITHOSPHERE IN TIEN SHAN AND PAMIR

NIKOLAYEV, A. V. and SANINA, I. A., Institute of Physics of the Earth imeni O. Yu. Shmidt, USSR Academy of Sciences, Moscow

[Abstract] In seismic probing each particular region must be intersected by rays transmitted in different directions; velocities are determined usually on the basis of the arrival time of the first waves from remote sources at the surface. Methods for studying a block model are based on the postulates of geometrical seismics. In essence the problem involves a selection of wave velocities in blocks which gives the best (in the sense of some criterion) correspondence between the observed and computed wave travel times. The specific method for solving the problem is outlined. A new algorithm is written for arriving at a solution in which the following representation is used: the medium consists of layers; the layers consist of equal blocks; the wave velocities in the blocks are constant; seismic waves do not change

directions in passing through the lateral boundaries of the blocks. The
algorithm is illustrated in studies of lithospheric structure in the Tien
Shan and Pamir. An important quality of the new algorithm is its ability to
eliminate the erroneous vertical extension of anomalies, characteristically
observed when older algorithms were used, which is important in relation to
interpretation of such anomalies and in attempts to reconstruct tectonic
processes. The proposed algorithm can be modified for a medium with a smooth
change in velocities, which evidently corresponds better to the true distri-
bution of velocities in the earth's crust and upper mantle. This method can
be used in seismic prospecting but this requires areal systems of obervations.
Figures 3; references 7: 6 Russian, 1 Western.
[153-5303]

SEISMIC DATA ON RELIEF OF MOHOROVICIC DISCONTINUITY ON BALTIC SHIELD

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Apatity

[Abstract] This is a review of all the most important published materials
on the relief of the Mohorovicic discontinuity on the Baltic shield, with
emphasis on the results obtained during the last five years. Figure 1 shows
the location of the most important seismic profiles; a table gives the
results of deep seismic investigations (length of observation profiles,
velocities of longitudinal waves refracted at the M discontinuity, depth of
Moho). It appears that depth and velocity have been determined quite
reliably for the Moho. The total thickness of the crust varies in the range
from 30 to 50 km. The boundary velocities along the M discontinuity vary
from 7.9 to 8.37 km/sec, apparently evidence of an inhomogeneous composition
of the upper mantle. An increase in crustal thickness (more than 40 km) is
noted in the central parts of Norway and Sweden, Gulf of Bothnia and in
southern Finland. Crustal thickness for the Baltic shield and adjacent
regions is for the most part identical. It was possible to make a rather de-
tailed map of the position of the Moho and tie in seismic data for an area of
about 50 000 km^2; this map is shown as Fig. 3 (central and southern parts of
Kola Peninsula). In the southern part of the peninsula, in the transition
zone from the crust to the mantle, there are two seismic discontinuities,
one above the other, separated by a distance of 8 km. The presence of two
seismic boundaries here with properties characteristic of the Moho can be
interpreted as a result of recently transpiring significant and relatively
rapid vertical movements of crustal blocks. Figures 3, tables 1; references
22: 11 Russian, 11 Western.
[157-5303]

SATURATION OF LEVEL OF ARTIFICIAL DISTURBANCES OF GEOMAGNETIC AND GEOELECTRIC FIELDS

CHERNOGOR, L. F., Khar'kov State University

[Abstract] Studies of the generation of artificial pulsations of the geo-magnetic field when the ionosphere is modified by powerful radio waves have shown that the effect is determined by the absorbed power of the radio wave. A saturation of the disturbances level sets in with total absorption of the radio wave. The author, exploring this problem in greater depth, gives an evaluation of the limiting (for a stipulated transmitter power) disturbances of the geomagnetic (Δ B) and geoelectric (Δ E) fields for electric and magnetic models of a source. (An arbitrary degree of disturbance of ionospheric parameters is considered.) First the article gives an evaluation of the limiting disturbance of electron temperature, followed by a corresponding examination of the disturbance of electron concentration. The limiting amplitudes of disturbances of the geomagnetic Δ B and geoelectric Δ E fields are evaluated. The modulated electric current jet constitutes an artificial antenna radiating at the modulation frequency. The type of this antenna is unclear. Evaluations are given for two models of a radiation source—electric and magnetic dipoles. Simultaneous measurement of the Δ B and Δ E values will make it possible to clarify the nature of the artificial source. Formulas are given for evaluating the anticipated effect. Tables 3; references 10: 8 Russian, 2 Western.
[157-5303]

PETROPHYSICAL INTERPRETATION OF VELOCITY DISTRIBUTION IN CRUST AND MANTLE

SEMENOVA, S. G., Geophysical Institute, Ukrainian Academy of Sciences, Kiev

[Abstract] Changes in the composition and structure of rocks with an increase in their regional metamorphism lead in turn to changes in the physical properties of metamorphic rocks in the lithosphere cross section. With an increase in temperature and pressure with depth, and with an effect on rocks by different fluids, the degree of their progressive metamorphism increases, during which the rocks become denser, change their mineralogical composition, becoming enriched with specific minerals of deep facies, which in general favors an increase in their density and the velocity of propagation of elastic waves. An increased iron content is formed in the rocks under

thermodynamic conditions of definite facies of metamorphism (amphibolitic and especially granulitic). An element with a high atomic weight, iron causes a decrease in the velocity of elastic waves in the minerals and rocks. This is favorable for the formation of waveguides in the earth's crust in regions of occurrence of rocks with a high iron content. Since rocks with a basic composition of the granulitic facies of metamorphism are characterized by a high iron content, in sectors where they occur there will probably be layers with reduced velocities of propagation of elastic waves. Formations of the eclogite facies of metamorphism (deep rocks with a high content of minerals having structures with very dense atomic packing) are characterized by a reduced quantity of iron. These factors, favoring an increase in the velocity of propagation of elastic waves in rocks, are responsible for the velocity jump at the Moho. Figures 4; references 22: 16 Russian, 6 Western. [157-5303]

SOLAR ACTIVITY AND EARTH CURRENT PULSATIONS

SEDOVA, F. I. and LITINSKIY, V. M., Institute of Applied Problems in Mechanics and Mathematics, Ukrainian Academy of Sciences, L'vov; Geophysical Institute, Ukrainian Academy of Sciences, Kiev

[Abstract] A long series of earth current pulsations registered at Korets (φ = 50°30', λ = 27!09') during the years 1958-1979 was analyzed to ascertain the response of this phenomenon to changes in solar activity during the 19th, 20th and beginning of development of the 21st cycles. With respect to Pc3 pulsations, with a characteristic period T = 25-30 sec, the epoch of high activity 1958-1959 was characterized by relatively short series with a sharp change in Pc2 and Pi1, corresponding to a magnetically disturbed field. During the epoch of the quiet sun 1964-1965 the most stable pulsations (12-14 hours) were observed, but they had a relatively small amplitude. The onset of the 21st cycle had two peaks in the distribution of Pc3 duration, indicating a predominance of shorter series. Depending on the level and cycle of solar activity there is a change only in the amplitude of the diurnal curve maximum. During epochs of minimum activity the amplitude of the mean annual diurnal variation was 1.5-1.3 times greater than during epochs of the maxima. In addition to regular Pc3, there are sometimes stronger pulsations with greater amplitudes and lesser periods and with a clear dependence on magnetic disturbance, at Korets being associated with the activity maximum in odd cycles and in general constituting about 10-15% of the total number of regular Pc3 registered during the year. The period of Pc4 is 50-60 sec. These pulsations usually occur as isolated events or short series and at near-midday as an amplitude modulation of regular Pc3 and are characteristic for a magnetically quiet field with a maximum occurrence at the solar activity minimum. At the beginning of the current cycle Pi2 are characterized by trains

of pulsations with a clearly expressed attenuating regime and are complicated by high-frequency pulsations of the Pil type whose activity has increased sharply. There are two types of Korets: random and sinusoidal pulsations with T = 4-6 sec, known as auroral agitation; the activity of the latter at the maximum of the odd cycles is almost proportional to the sunspot number. Pc2 pulsations are also associated with the maximum activity of odd cycles; they are characterized by a sinusoidal form, duration of series up to 10-12 hours and predominant periods of 6-10 sec. The Pcl pulsations at Korets have a period less than 2 sec and the duration of the series is from a half-hour to several hours; 80% of these events are associated with weak disturbance in the geomagnetic field, with the maximum of occurrence being in an epoch of rapid dropoff of solar activity. Figures 4; references: 11 Russian.
[123-5303]

GROUP MAGNETOTELLURGIC SOUNDING ON UKRAINIAN SHIELD

ROKITYANSKIY, I. I. and KREYMER, S. G., Geophysical Institute, Ukrainian Academy of Sciences, Kiev

[Abstract] The magnetotelluric field was investigated at 15 points to the southwest of Korovograd in 1977. The field polarization at most points was quasilinear; the direction of predominant polarization changes randomly from point to point, indicating a local nature of the inhomogeneities responsible for this polarization. With an increase in the period of variations the telluric field vector has a tendency to rotation in a meridional direction, across the strike of the Ukrainian shield. In the work area there are several major steeply dipping deep faults whose conductivity is presumably high. In general, the level and shape of the curves constructed for each point differ insignificantly, which indicates a consistent nature of the geoelectric section. Accordingly, the collected data were treated as one group magnetotelluric sounding. Averaged longitudinal and transverse curves were constructed and various local distortions were analyzed. Then a single smoothed curve was used in the interpretation. It was found that the resistivity of the section decreases from 110 ohm·m at a depth of 25 km to 20-40 ohm·m at a depth of 70 km with the sharpest decrease in resistivity at 40 km. On the assumption that most of the crystalline Precambrian rocks of the Ukrainian shield have a resistivity $\rho \gg 10^3$ ohm·m, it can be concluded that most of the total longitudinal conductivity of the upper 25-km layer is concentrated in a relatively thin crustal waveguide registered at a depth of 6-13 km. Interpretation of the corrected curve suggests presence of a conducting layer at a depth of 80-100 km with a total conductivity of at least 400 mho. Figures 4; references 7: 5 Russian, 2 Western.
[123-5303]

EXPERIENCE IN USE OF DIFFRACTION TRANSFORMATION OF SEISMIC RECORDS

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[Abstract] The article gives the results of diffraction transformation of
field seismic records registered during the exploration of petroleum and gas
areas in northern Sakhalin. The general approach is based on a minimum of a
priori information on the geological structure in the absence of an initial
record for the purpose of discriminating a useful signal along a so-called
"summed" travel-time curve. As a background for description of the algorithm
and program the article briefly outlines the pertinent seismogeological
conditions in northern Sakhalin. The medium in this region is slightly
inhomogeneous, making it possible to solve the inverse seismic problem by the
mean velocities method. The method is illustrated by the results of processing
of multiple seismic observations along a specific profile. The particular
problems in applying the method of summing of the travel-time curves are dis-
cussed. It is shown that when there is a high quality of the field data and
there is no noise masking the useful signal the reflecting boundaries in
diffraction transformation sections are expressed more clearly and are traced
to a greater depth than when traditional methods are used. Diffraction trans-
formation sections are therefore closer to a real geological model. It is
clear that in tectonically complex sectors there is a need for three-dimensional
observations; diffraction transformation constitutes one of the most effective
methods for the processing of such three-dimensional observations. This
method for the processing of data from multiple seismic observations supple-
ments the common shot point method. Figures 6; references: 3 Russian.
[123-5303]

METHOD AND PROGRAM FOR DETERMINING VELOCITIES AND ANGLES OF WAVE EMERGENCE
FROM COMMON SHOT POINT SEISMOGRAMS

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[Abstract] Under complex seismogeological conditions the wave field is
characterized by the interference of reflected waves caused by a change in
the propagation paths of oscillations due to the influence of curvilinear

and steeply dipping refracting and reflecting boundaries or forming at
horizons differently oriented in space. Since these waves are propagated
in the same layer of sediments, the kinematic characteristics of their
travel-time curves differ insignificantly and therefore existing processing
procedures, based on the separation of waves on the basis of the kinematic
differences of their travel-time curves, are ineffective. Under these
conditions the reflected waves differ with respect to angles of emergence
and with respect to the form of the travel-time curve t_0, which can be used
in processing data by a simultaneous analysis of two parameters: the gradient
of the change in time of registry of a reflected wave t_0 and the velocity of
propagation of oscillations V_{eff}. The sought-for parameters are determined
from common shot point seismic records. The algorithm and program described
in this article make it possible to obtain definite values of the effective
velocities in the profile interval for which velocity is determined from a
group of common deep point travel-time curves with the introduction of
kinematics computed for common shot point travel-time curves. Materials
obtained by the continuous profiling method with multiple overlapping are
used in the processing. The described method uses two interference systems:
the first is for discriminating reflected waves from a stipulated direction,
whereas the second is for determining the curvature of the summed travel-time
curve, that is, effective velocity. The effectiveness of this method is
dependent on the parameters of the interference systems: length of processing
and registry base, period of oscillations, wave length and distances between
sources and receivers of oscillations. Some of the advantages of the method
are as follows: the successive use of two processing systems directed to
the separations of waves on the basis of two parameters; use of the inter-
ference system in the first processing stage ensures an improvement in the
signal-to-noise ratio and in the second processing stage makes it possible to
use a more complex algorithm and accordingly increase resolution of the
method. Figures 4, tables 1; references 5: 4 Russian, 1 Western.
[123-5303]

THEORY AND INTERPRETATION OF STATIONARY FIELDS OF THERMAL NEUTRONS STUDIED
BY NUCLEAR GEOPHYSICAL METHODS

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[Abstract] At present the method of quantitative interpretation of data from
geophysical studies by the neutron-neutron method with thermal neutrons is
being developed by solving direct problems is geophysical neutronometry.
However, its effectiveness is governed by the adequacy of the physical model
used in theoretical description of the processes of moderation and diffusion
of neutrons in geological media. In many cases the selected model cannot

give satisfactory quantitative results since the considered conditions are beyond the framework of applicability of the age and diffusion equations and the P_1 approximation of the spherical harmonics method lying at their basis. The author, continuing his extensive work in this field, has developed improved and more rigorous formulations of the direct problem for providing more universal and accurate solutions. In earlier studies (GEOFIZ. ZH., 2, 1, 13-26, 1980; 3, 3-15, 1981) the author demonstrated that the use of a P_2 approximation of the spherical harmonics method is superior to the P_1 approximation; this was demonstrated in a description of the diffusion of thermal neutrons in rocks (DOKL. AN UkSSR, SER. B, 2, 23-27, 1981). This new article, building on this earlier series of investigations, deals with the spatial distribution of thermal neutrons caused by moderation of fast neutrons of a point monoenergetic source in an infinite homogeneous medium of arbitrary composition. The paper gives the derivation of integral-free expressions for the flux density and relaxation length of the thermal neutron field. These expressions clearly correlate these parameters and other macroscopic neutron parameters. This makes possible a broadened possibility for a quantitative interpretation of geophysical data obtained by stationary neutron-neutron methods. References: 15 Russian.
[123-5303]

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ELASTIC PROPERTIES OF INDIAN OCEAN BOTTOM FORMATIONS IN DIFFERENT MODEL
PT CONDITIONS

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 4, No 1, Jan-Feb 82
(manuscript received 1 Sep 80) pp 17-33

LEBEDEV, T. S., KORCHIN, V. A., BURTNYY, P. A. and RUSAKOV, O. M.,
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[Abstract] The authors present new results of an experimental study of changes of a complex of elastic properties and density of air-dried and water-saturated samples of crystalline formations from the floor of the Indian Ocean in model laboratory PT regimes. The samples were taken on the 19th voyage of the "Akademik Vernadskiy" in 1978-1979. Most of the work was done in the Arabian Sea-Indian Ocean Ridge region. A table gives the mineral composition of the dredged samples. The elastic characteristics and density at atmospheric pressure and at room temperature are discussed in great detail, followed by a description of experiments at a hydrostatic pressure up to 5 kbar and also under the simultaneous influence of high P and T. All these experimental data made it possible to draw a series of generalizations, such as the following. The investigated bottom formations can be divided into high-velocity (gabbros, dolerites and basalts) and low-velocity (modified gabbros and slightly crystallized basalts). The rocks of the oceanic crust, saturated with water, are characterized by an increase in the velocity of propagation of longitudinal waves. They are more plastic and mobile under

- 61 -

different thermopressure conditions in comparison with their air-dried analogues. The air-dried and water-saturated samples of bottom rocks were characterized by clear correlations between V_p, V_s and densities. The dependences V_p, $V_s = f(\mathcal{P})$ are also retained at high P and T. They can be used in predicting the depth distribution of the density of mineral matter of the oceanic crust. The changes in V_p and V_s at high hydrostatic pressure in samples of bottom formations are related to the structure and mineral composition of the latter. Experiments carried out by the method of programmed modeling of the corresponding P and T distributions in the earth's crust revealed that V_p, V_s change in conformity to complex laws with different dV_p/dH and dV_s/dH values. A general pattern is observed: under PT conditions corresponding to depths of more than 10-15 km the increase in density is more intensive than observed at lesser depths. The newly collected data on the velocities of seismic waves and the thicknesses of the main crustal layers of the rift zone indicate that the blocks of its individual ridges in the upper parts consist of rocks in which the velocities of longitudinal waves are about 5-6 km/sec. At a depth of 7-12 km from the ocean surface there are formations in which V_p attains 6.8-7.2 km/sec, and deeper, 9-10 km/sec. It appears that the first 5 km of the bottom rocks can be represented by slightly crystallized modified basalts and gabbros completely saturated with water or salt solutions. In this region deep seismic sounding data reveal two layers with velocities of elastic waves of about 6.8 and 7.0-7.2 km/sec. The first evidently consists of slightly crystallized basalts with a low water content. The second can be represented mostly by unmodified gabbros considerably enriched with pyroxene and olivine. Seismic data at depths greater than 15-18 km indicate the presence of rocks with velocities of longitudinal waves 8.2-9.0 km/sec. The presence of mineral formations enriched with pyroxene and olivine is postulated. Figures 11, tables 4; references 34: 24 Russian, 10 Western.
[123-5303]

COMPUTING AMPLITUDE SPECTRUM OF GEOPHYSICAL FIELDS

ALEKSIDZE, M. A., ZASLAVSKIY, V. N. and TSULEYSKIRI, L. G., Geophysical Institute, Georgian Academy of Sciences, Tbilisi

[Abstract] In the processing of geophysical data it is common to find the amplitude spectrum for the geophysical field $f(\omega_k)$ (ω_k is the number (frequency) determining the harmonic). The $f(\omega_k)$ values have been computed with very low frequencies ω_k for which the corresponding wavelengths are comparable to or greater than the length of the observation segment. In many cases the amplitudes of these extremal frequencies make it possible to draw important conclusions and therefore it is essential that they be correctly computed. Accordingly, the authors have made a detailed study of

the problem of finding the amplitude spectrum. This essentially involves
the following. It is necessary to find such an amplitude $f(\omega)$ for the
harmonic sin $[\omega t + \varphi(\omega)]$ (or cos $[\omega t + \varphi(\omega)]$), where $f(\omega)$ is the
initial value, at which the difference

$$\Delta [t, f(\omega), \varphi(\omega)] \equiv \psi(t) - f(\omega) \sin [\omega t + \varphi(\omega)]$$

will no longer contain this harmonic. (The problem is complicated by the fact
that the initial phase $\varphi(\omega)$ when finding the amplitude $f(\omega)$ is not known
and it is necessary to find the value minimizing $\Delta[t, f(\omega), \varphi(\omega)]$.)
Proceeding on this basis, a full algorithm is formulated which greatly facili-
tates solution of the problem and enhances accuracy in ascertaining the
amplitude spectrum. Figures 3, tables 3; references: 2 Russian.
[123-5303]

TASKS OF UKRAINIAN ACADEMY OF SCIENCES GEOPHYSICISTS AT PRESENT STAGE

CHEKUNOV, A. V., Geophysical Institute, Ukrainian Academcy of Sciences, Kiev

[Abstract] The Geophysical Institute, Ukrainian Academy of Sciences, carried
out an extensive work program during the years of the 10th Five-Year Plan,
which included the following. In collaboration with East European specialists,
it was possible to clarify the principal patterns of deep structure of the
crust and upper mantle in eastern and central Europe. Structural diagrams
of the surface of the basement and bottom of the consolidated crust were
constructed. Seismogeological sections were constructed along the principal
geotraverses intersecting the European continent from the Black to the
Adriatic Seas in the south to the Baltic and Barents Seas in the north. This
made it possible to regionalize a vast area with respect to deep structure.
A map of heat flow was compiled for the European continent and the existence
of global, regional and local heat fields was established. The principles
for constructing a geothermal model of the distribution of heat sources,
thermal conductivity and temperatures were formulated for the principal
tectonic structures in the southwestern USSR and it was found that there is
a close correlation between the development of thermal processes and dynamics
of the deep layers. A method for constructing a magnetic model of the crust
on the basis of regional anomalies was developed and successfully applied
within the limits of the Ukrainian and Baltic shields. The first integrated
map of the anomalous magnetic field was compiled for the Ukrainian shield for
a further investigation of the tectonics, deep structure and mineral resources
of Precambrian formations. A method was developed for the interpretation of
complex gravitational fields and algorithms were formulated for the mathematical
modeling of crustal structure and prediction of deposits of petroleum, gas
and ore on the basis of gravity and magnetic data. A map of the distribution
of electromagnetic anomalies was compiled and new major conductivity anomalies
were discovered. A map of recent crustal movements was compiled for the

southern European USSR. This, being but a partial enumeration of the
activities of the institute, was supplemented by extensive work in such areas
as creation of automated systems for the interpretation of geophysical data
and the development of new geophysical instruments for observations in deep
and superdeep boreholes. During the years 1981-1985 some of the main goals
of the institute will be as follows. Study of the crust and upper mantle by
a variety of geophysical methods for determining the patterns of their
structure, composition and history of formation, and on this basis prediction
of mineral deposits. Study of modern geodynamics and earthquake prediction.
Development and improvement of the theory and methods of geophysical explora-
tion for mineral deposits. Formulation of a theory and creation of automated
systems for the multisided interpretation of geophysical data and new geo-
physical instrumentation. Many of these goals are spelled out in greater
detail in this review of the institute's recent and future programs.
[123-5303]

METHOD FOR DESCRIMINATING AND RECONSTRUCTING IMPARTED STRESS FIELDS

KORCHEMAGIN, V. A. and YEMETS, V. S., Donets Polytechnic Institute

[Abstract] An effort was made to advance further in the theoretical kinematic
analysis of tectonic dislocations by means of reconstruction of the field of
imparted stresses. The fundamental principles of this analysis, developed by
a long series of authors, remain unchanged in a study of brittle deformations
arising under the influence of different stress fields. Here the authors
examine a method for reconstructing the stress field using a model of the
medium and its stressed state similar to the model described by B. V. Kostrov
in MEKHANIKA OCHAGA TEKTONICHESKOGO ZEMLETRYASENIYA, Moscow, Nauka, 1975.
A study is made of a geological volume cut by arbitrarily oriented systems of
weakened discontinuities in which a uniform stress field is operative. The
deformation in this anisotropic volume develops by displacements along all
the fractures in conformity to plasticity theory. A system of expressions is
derived for describing the model and the phenomena arising in it and the
difficultires involved in solving the problem are discussed. A stereographic
method is developed and applied for determining the admissible variants of
orientation of the axes of the main normal stresses. In this sophisticated
approach the studied volume, penetrated by two dislocations, is divided into
four quadrants. The four types of regions which arise are analyzed individually
and in pairs. A full solution of the problem of reconstructing the stress
field is obtained. The possibility of dividing and reconstructing the stress
field is dependent on the degree of mismatching of the stress axes and also on
the intensity of their manifestation. Figures 2; references 11: 9 Russian
2 Western.
[169-5303]

TRANSVERSE DEEP FAULTS IN KURILE ISLAND SYSTEM

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[Abstract] The largest transverse faults in the Kurile Island system penetrate
the entire thickness of the earth's crust and extend into the upper mantle.
Laterally they are manifested quite clearly not only within the limits of the
island rise, but also beyond its limits in the direction of the Okhotsk Sea
depression and in the direction of the ocean basin (this is evident in a
series of sections shown in Fig. 1). This island system is characterized
by the presence of two major transverse faults and two smaller faults. The
inhomogeneity of island arc structure in strike is reflected in the intensity
and nature of release of seismic energy and in details of the structure and
dynamic characteristics of the zone of earthquake foci (graphically represented
in Fig. 2). The volume density of the radiation of seismic energy for the
focal zone sector in the northern Kuriles is approximately twice as great as
for the middle Kurile sector. These differences in the nature of release of
seismic energy in different sectors of the focal zone agree with the nature
of distribution of the velocities of seismic waves along the strike of the
island system. The upper mantle of the middle Kurile region is characterized
by more plastic properties and therefore lesser possibilities for the con-
siderable accumulation of elastic energy then the mantle in the flanking
sectors of the island system. The probably depth of the transverse faults
can be judged from the morphology of the focal zone in its longitudinal
section. It appears that the transverse faults penetrate to the level of the
deepest-focus earthquakes, that is, to 300-600 km from the surface of the
geoid. About 60% of the foci of earthquakes with depths of more than 200 km
are concentrated along the bottom of the focal zone and in the zones of the
transverse faults. The limits of change in the character of deformation in
general correspond to the position of the large transverse faults in the
crust and mantle. Figures 2; references: 8 Russian.
[175-5303]

VARIABILITY OF SOME PARAMETERS OF PELAGIC Fe-Mn NODULES

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[Abstract] The author's earlier analysis of Fe-Mn nodules in the central part
of the Indian Ocean (LITOL. I POLEZN. ISKOP., No 5, 1981) and the literature
in general indicate a great variability of the productivity of the nodules,
their morphology and surface characteristics, textures, mineral and chemical
compositions. In seeking to clarify this problem, the article first gives a
formula for computing the reserves of metals in pelagic Fe-Mn nodules,
followed by the introduction of the new coefficient K: the mean ratio of the
mass of the ore part of the nodules to their total mass. It is pointed out
that there are four types of Fe-Mn formations which differ with respect to
the ratio between the ore and nonore parts: 1) coarse material covered with
a film of Fe-Mn hydroxides; 2) nodules with a virtually one-free nucleus;
3) nodules with an admixture of ore matter in the nuclear part; 4) completely
mineralized nodules. The K values vary from close to zero for formations of
the first type to almost unity for nodules of the fourth type. A formula is
derived for determining K at a specific geological station. The author also
investigated the variability of concentrations of Cu, Ni, Co and Σ Cu, Ni,
Co (Σ ore elements) in pelagic nodules. The variability of productivity
of pelagic Fe-Mn nodules is considerably greater than the variability of the
concentrations. Finally, a formula is derived for the reserves of the con-
sidered elements per unit area (1 m^2), this giving the specific reserves; the
latter is an extremely important value and should be determined at each
station where Fe-Mn nodules are found. As defined in the article, the
"productivity" of nodules is a more important parameter than the content of
ore elements. Figures 3, tables 2; references 4: 3 Russian, 1 Western.
[175-5303]

QUASIELASTIC MODEL OF BEDROCK DEFORMATION

ZAMYSHLYAYEV, B. V., YEVTEREV, L. S. and PILIPKO, Yu. V., Institute of Physics
of the Earth imeni O. Yu. Shmidt, USSR Academy of Sciences, Moscow

[Abstract] The deformation of bedrock situated beyond the volume of macro-
dislocations created by an explosion differs appreciably from elastic. This
is because real rock masses are not ideal media but are cut by networks of

fissures which may or may not be connected with one another. In the latter case the non-idealness of behavior of the bedrock during the propagation of shot waves is governed by the interaction of these fissures with the fields of stresses and strains. This interaction conforms to the geometrical similarity law in a wide range of source energies (10^{10}-10^{19} erg). However, any adequate deformation model must explain such experimental facts as the existence of a definite range of change of the attenuation coefficient n of the amplitudes of disturbances and an increase in the time of increase in signal strength to a maximum with distance. The main inadequacy of traditional models is that in these the relaxation rate is not dependent on the rate of transpiring of the process. The authors feel that in formulating the equations of a quasielastic model it is essential to take into account the dependence of the relaxation rate on the rate of deformation and that at the same time the model must reflect important known characteristics of bedrock deformation: the difference in the static and dynamic volumetric and shear moduli, the difference in the trajectories of loading and unloading in a stipulated plane, and the dependence of the relaxation rate on the load level. A new equation of state was derived to take these circumstances into account and after validating this quasielastic equation of state the authors proceed to a description of numerical modeling of laboratory experiments with uniaxial deformation and propagation of shot waves. This modeling revealed that the formulated quasielastic model is described by expressions which are invariant relative to a change in scale and time, the numerical computations did not reveal any substantial deviation of the amplitude-time characteristics from the law of geometrical similarity with variance of source energy E_0 in the broad range $E_0 \sim 10^{10}$-10^{19} erg. Figures 4; references 14: 7 Russian, 7 Western.
[175-5303]

EARTH TIDES AND VARIATIONS OF PHYSICAL CHARACTERISTICS OF ROCKS

D'YAKONOV, B. P. and ULITIN, R. V., Geophysical Institute, Ural Scientific Center, USSR Academy of Sciences, Moscow

[Abstract] Since 1978 specialists at the Geophysical Institute, Ural Scientific Center, have been carrying out work on instrumentation and methods directed to an investigation of variations of physical fields and physical properties of rocks caused by a change in the stressed state of rock masses. The article examines the change in parametric effects, that is, the change in the physical parameters of the medium (seismoacoustic emission, conductivity), due to the effect of volume forces of lunar-solar earth tides. Temporal changes in conductivity caused by earth tides were discovered when measuring the effective resistivity of rocks by the method of dipole electric sounding. Processing

of several cycles of continuous observations revealed that the effective resistivity of the medium ρ_k changes in the course of 24 hours with a distinct diurnal and semidiurnal periodicity; the correlation coefficient of ρ_k variations with gravity increments Δg and slopes of the earth's surface is close to 0.75; the relative change in effective resistivity during the diurnal cycle is up to 5%; the maximum ρ_k values are observed with maximum Δg values. Since the conductivity of rocks is governed for the most part by the liquid phase filling fissure space, the change in earth tides can be attributed to the closing (during rock compression) or opening (during dilatation) of some of the conducting channels. The conductivity of water-saturated rock masses is a quite sensitive indicator of weak variable deformations. The changes in rock conductivity under the influence of earth tides can be used as another parameter characterizing the peculiarities of geological structure of a rock mass and its reaction to dynamic effects. In some geological structures a study was also made of the temporal variation of seismoacoustic emission (s.a.e.) in the frequency range 20-100 Hz. It was found that s.a.e. in the mentioned frequency range is not directly related to remote sources of microseisms; the s.a.e. of rocks changes with time and there is a clearly expressed semidiurnal and diurnal periodicity; the correlation coefficient of variations of s.a.e. with the increments of gravity Δg and slopes of the earth's surface is 0.8; the maximum s.a.e. values are registered during maximum Δg values; the absolute levels and relative amplitudes of diurnal and semidiurnal variations are related to the geological characteristics of the observation point. Figures 2, tables 1.
[175-5303]

UNIQUENESS OF SOLUTION OF TWO-DIMENSIONAL INVERSE PROBLEMS IN GRAVIMETRY AND MAGNETOMETRY FOR POLYHEDRONS

BRODSKIY, M. A. and STRAKHOV, V. N., Institute of Physics of the Earth imeni O. Yu. Shmidt, USSR Academy of Sciences, Moscow

[Abstract] The problem of discriminating classes of sources of gravitational and magnetic fields within whose framework there is uniqueness of solution of inverse problems is examined here from a new point of view. Traditionally use has been made of nonparametric classes of distributions of field sources, but as pointed out here, it is equally important to examine parametric classes in which the distribution of sources is described by a finite number of numerical parameters. In the case of a plane problem there is a class of polyhedrons within whose framework it is natural to approximate the real distributions of masses and conductivities. This article outlines a number of theorems of uniqueness of solution of inverse problems in this class on the basis of application of the new demonstration technique, specifically,

constructing the internal field on the basis of the external field. The problem is formulated as follows: $s = x + iz$ ($\sigma = \xi + i\zeta$) are the complex coordinates of points on the plane C^1; E_N is an arbitrary simply connected polyhedron with N vertices with the coordinates σ_v, $v = 1, 2,...,N$; $\sigma_{N+1} = \sigma_1$. It is assumed that the polyhedron E_N is filled with masses of the constant density δ and is situated in the lower half-plane $z = \text{Im } s < 0$, whereas in the upper half-plane there is stipulation of the complex strength $G_e(s)$ of the external field. The inverse problem in gravimetry involves determination of E_N and the density δ from $G_e(s)$. The theorems which are formulated make it clear when the solution of the problem is and is not unique, with separate consideration of problems in both magnetometry and gravimetry. Figures 2; references 12: 11 Russian, 1 Western. [175-5303]

APPARATUS AND METHOD FOR STUDYING ACOUSTIC ANISOTROPY OF ROCKS

PRODAYVODA, G. T., Geology Faculty, Kiev State University imeni T. G. Shevchenko

[Abstract] The author has developed a rigorously sound method for studying the acoustic properties of rocks as statistically homogeneous anisotropic media in the case of an arbitrary orientation of the working coordinate system, with introduction of a rigorous quantitative measure of the anisotropy of the acoustic properties of rocks and a laboratory ultrasonic apparatus is described for applying the proposed method. The theoretical premises of the method are first outlined. The introduced acoustic constants characterize the total square velocity of propagation of compressional (dilatational) stresses in the anisotropic medium as a whole. The use of an acoustic tensor simplifies construction of a rigorously sound method for study of medium anisotropy in the absence of a priori information on the spatial position of its elements of symmetry. In such a case there can be an arbitrary orientation of the working orthogonal coordinate system and it becomes possible to measure the three velocities of elastic waves (one quasilongitudinal and two quasitransverse) in six nonequivalent directions. A formula is derived for determining the values of the acoustic tensor components. The acoustic anisotropy parameter is introduced as the degree of deviation of this anisotropic medium from the closest isotropic medium; an appropriate expression is introduced for this procedure. The apparatus developed at Kiev State University is designed for studying the velocities of elastic waves in inhomogeneous strongly absorbing media. The method essentially involves optical superposing of two pulses, one of which is propagated through a delay line and the other being propagated through identical delay lines between whose ends the investigated sample is placed. The two signals are compared by

their optical superimpositioning on the screen of a two-ray oscillograph. The scanning frequency at which the pulses coincide makes it possible to determine the time required for propagation of the acoustic pulse through the investigated sample. The full operating principle of the apparatus is described, accompanied by a block diagram. With development of a special field variant of the apparatus the method can be used in both acoustic and seismic investigations under natural bedding conditions. Figures 3, tables 1; references: 27 Russian.
[159-5303]

DETERMINING FOCAL DEPTHS OF REMOTE EARTHQUAKES FROM FUNDAMENTAL TONE AND OVERTONES OF RAYLEIGH SURFACE WAVES

ARKHANGEL'SKAYA, V. M., Institute of Physics of the Earth imeni O. Yu. Shmidt, USSR Academy of Sciences

[Abstract] In earlier articles by the author (IZV. AN SSSR: FIZIKA ZEMLI, No 3, pp 110-116, 1977; No 2, pp 99-109, 1978) the first use was made of observations of both the fundamental tone and overtones of Rayleigh surface waves in determination of focal depths. It was graphically shown that overtones form an important part of the field of surface waves. There is an increase in the relative intensity of displacements in the overtones in comparison with the intensity of the fundamental tone on the records of one and the same seismogram with earthquake focal depth and this serves as the basis of the proposed simple method for determining the focal depths of remote earthquakes on the basis of Rayleigh surface waves. The method was developed on the basis of records of the fundamental tone and overtones of Rayleigh surface waves from 150 earthquakes with focal depths from 0-10 to about 150 km registered at Tiksi and Noril'sk. The basic tool is graphs of the dependence of the ratios of maximum amplitudes in the overtones to the maximum amplitudes of the fundamental tone on one and the same seismogram on source depth: $A_{over}/_{fund} = f(h)$. The author has now continued this line of research using new data for other stations in different geological regions in order to demonstrate that the method for determining focal depths can be applied to any seismic station in the Soviet Union. Data for 120 stations in Central Asia were used. The comparison of the averaged dependence $A_{over}/A_{fund} = f(h)$ with an accuracy to ± 5 km (in the depth range h from 50 to 100 km the coincidence is almost complete) with data obtained for stations in many different areas indicates a universality of this dependence and the possibility of its use in determining the focal depths of earthquakes at any stations in the USSR. Figures 5, tables 1; references 12: 11 Russian, 1 Western.
[159-5303]

COMPENSATION FUNCTIONS METHOD AND ITS APPLICATION IN DETERMINING SINGULARITIES
OF GEOPHYSICAL FIELDS SATISFYING THREE-DIMENSIONAL LAPLACE AND HELMHOLTZ
EQUATIONS

VOSKOBOYNIKOV, G. M. and SHESTAKOV, A. F., Geophysical Institute, Ural
Scientific Center, USSR Academy of Sciences

[Abstract] Compensation functions were first used by M. M. Lavrent'yev who
employed them in obtaining an effective solution of the Cauchy problem for
two- and three-dimensional Laplace equations. G. M. Voskoboynikov later used
compensation functions of a complex variable in obtaining a two-dimensional
variant of the method for determining singularities of potential fields in-
tended for interpretation of geophysical data. The quite high effectiveness
but the limited possibilities of applying the purely two-dimensional variant
necessitated its extension to three-dimensional fields. Some attempts have
been made to solve the three-dimensional problem, but in those efforts the
problem is essentially reduced to a two-dimensional case by implicit or
explicit representation of the three-dimensional case and its sources on a
plane, resulting in loss of some of the information. In this article the
authors develop an effective method for determining the singularities of
three-dimensional potential fields. The problem is solved using a compensa-
tion function of real variables; the Laplace and Helmholtz equations are
satisfied. The article successively sets forth the physicomathematical
principles of the method and the principles for developing computation schemes
for determining the coordinates, type and orientation of field singularities.
This is followed by an outline of methods for organizing the initial data for
the formulated problem and a discussion of the prospects for applying the
method in the interpretation of the most important geophysical fields.
Figures 4; references: 12 Russian.
[159-5303]

SOLUTION OF INVERSE PROBLEMS IN GRAVIMETRY FOR SEVERAL CONTACT SURFACES

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S. I. Subbotin, Ukrainian Academy of Sciences

[Abstract] In a book published by the author (USTOYCHIVYYE CHISLENNYYE METODY
V ZADACHAKH GRAVIMETRII (Stable Numerical Methods in Gravimetric Problems),
Kiev, Naukova Dumka, 1978) there was extensive discussion of the formulation

of inverse two-dimensional problems in gravimetry for several contacts, both linear and nonlinear cases being considered, and algorithms were outlined which can be used in solving these problems. During recent years these problems have been solved and these solutions constitute the content of this article. Particular attention is given to the nonlinear (more difficult) problem. In comparison with the book the set of regularizing methods has been expanded and they have a higher accuracy. There is a detailed description of the computer application of the algorithms. The results of solution of problems in model examples for different noise levels of the initial field are presented. The nonlinear problem is solved by different methods for one, two and three contacts. In solving the linear problem it is necessary to determine the excess densities of the layers which are situated between known contact surfaces. The solution of the nonlinear problem makes it possible to reconstruct the position of several contacts if the densities of the layers are known as well as the position of the upper (or lower) contact is known. The effectiveness of the described methods for solving the formulated problems is illustrated in model examples. The algorithms are convenient for studying geological objects with a horizontally layered structure on the basis of the gravity field. Figures 5, tables 5; references 20: 19 Russian, 1 Western.
[159-5303]

NEW CHARACTERISTICS OF EXTENT OF FOCAL REGION OF NEAR EARTHQUAKES

GORBUNOVA, I. V. and KAL'MET'YEVA, Z. A., Institute of Physics of the Earth imeni O. Yu. Shmidt; Seismology Institute, Kirghiz Academy of Sciences

[Abstract] A new approach is made to the interpretation of waves from near earthquakes. An extended rather than a point focus is assumed. The radiation in this source does not occur instantaneously but in the course of some time interval. With such an approach in addition to the first arrival of P waves an analysis is made of the P_{max} wave, which is interpreted as a wave radiated at the time of the most intensive destruction in the earthquake focus. This makes it possible to proceed from a point source to an extended source by a simple method. By an "extended" focus is meant a horizontal fracture (or its projection onto the earth's surface) which extends in time from the initial point of rupture of continuity of the medium up to the time of release of the maximum seismic energy. The proposed method requires that the epicenters be surrounded by a satisfactory number of seismic stations in different azimuths. Seismograms from detailed seismological observations were used. The location of the seismic stations made possible a good azimuthal encirclement in the range of epicentral distances 0-180 km where secondary (exchange or reflected) waves have still not appeared. Data for 18 earthquakes were used. For these

the azimuthal distribution of the lag time of the P_{max} wave relative to the
first arrival conformed to the pattern postulated for an extended focus. An
azimuthal travel-time curve is constructed on the basis of the arrival time
of P_{max} waves. The authors demonstrate that azimuthal travel-time curves make
it possible to confirm the focal origin of the P_{max} wave and to estimate the
extent of the focal region and the direction of propagation of a fracture.
Figures 5; references 18: 10 Russian, 8 Western.
[159-5303]

PREDICTING SITES OF OCCURRENCE OF STRONG EARTHQUAKES IN MAJOR SEISMOGENIC
ZONES IN TAJIKISTAN .

MALAMUD, A. S. and KULAGIN, V. K. (deceased), Institute of Seismic Resistant
Construction and Seismology, Tajik Academy of Sciences

[Abstract] The authors have constructed a preliminary predictive map of the
sites of occurrence of strong earthquakes in major seismogenic zones of Tajik-
istan and adjacent regions. The nature of the release of seismic energy is
traced using space-time curves representing the sequence of its release in
different sectors. Figure 1 is a map of the epicenters of strong earthquakes
in the South Tien Shan epicentral zone during 1907-1978 and the predicted
sites of future earthquakes. Figure 2 is a graph of space-time curves such
as used in construction of the predictive map. The following appears to be
the sequence of release of seismic energy in epicentral zones. An earthquake
develops in some part of the considered seismogenic zone at some initial time.
Then a strong tremor occurs in another sector. As time passes there is a
tendency for earthquakes to develop in the intervals between the tremors
occurring earlier. The focal regions of the newly occurring earthquakes
virtually do not overlap; each successive event seemingly tends to fill the
still existing gap between the transpiring events. It is concluded that the
sectors of the epicentral zone which over the course of a long period are the
sites of minimum energy release are the most probable regions of the occurrence
of strong earthquakes in the future. On this basis it was possible to plot
the most probably sites of the occurrence of earthquakes with $M \geqslant 5.5$. Two of
the predicted sites were "triggered" in 1978. Figure 4 is the prediction map
for Tajikistan and adjacent areas. Figures 4; references 12: 10 Russian
2 Western.
[159-5303]

RESULTS, COORDINATION AND PROSPECTS OF DEVELOPMENT OF GEOLOGICAL AND
GEOPHYSICAL RESEARCH IN PACIFIC OCEAN BASIN

TUYEZOV, I. K. and KULYNDYSHEV, V. A.

[Abstract] A conference on the coordination of marine geological and geo-
physical investigations in the Pacific Ocean basin was held at Khabarovsk
during the period 12-14 October 1981. The objectives of the conference were
as follows: 1) examination of results of marine geological and geophysical
research obtained by scientific research and field organizations working in
the Pacific basin, 2) discussion of the principal directions in marine geo-
logical and geophysical research, 3) review of work plans for the Pacific
Ocean in the 11th Five-Year Plan and preparation of a multisided program.
The first part of the meeting involved presentation of reports by different
organizations on work results and plans and the second part was devoted to
reading of scientific reports. Eighty persons representing 28 organizations
participated in the meeting; 35 reports were presented. Among the problems
discussed were the geology of the Pacific Ocean superregion and tasks involved
in further regional investigations, plate tectonic evolution of the western
part of the Pacific Ocean in the Mesozoic and Cenozoic, density models of
the Pacific Ocean lithosphere and patterns of distribution of solid minerals
on the shelf of Far Eastern seas. There are significant shortcomings in
geological and geophysical investigations in the Pacific Ocean basin. These
include a poor level of interdepartmental cooperation and coordination, as a
result of which work frequently overlaps in the same ocean areas. In geo-
logical research virtually no use in being made of underwater apparatus for
ohotographing the sea floor and side-looking sonars are not in use. Deep
seismic sounding work has virtually ceased. Marine electromagnetic and
seismological observations are not being developed. Inadequate use is being
made of paleoecological, morphotectonic, paleomagnetic and geodynamic research
methods. The generalization of the abundant factual material accumulated both
during the 10th Five-Year Plan and in the preceding years is proceeding very
slowly. There is a need for preparing major generalizations such as a
"Tectonic Map of the Earth's Pacific Ocean Segment," "Geological Map of the
Pacific Ocean Mobile Zone and the Pacific Ocean," "Tectonic Map of the Eastern
USSR and Adjacent Regions," and collective monographs such as "Structure of
the Earth's Crust and Upper Mantle in the Transition Zone From the Asiatic
Continent to the Pacific Ocean" and "Geology of the Pacific Ocean Mobile Zone
and Pacific Ocean." Many recommendations were made, among them the following.
There should be a monograph on the fundamental problems of geology, geophysics,
geochemistry and geomorphology of the Pacific Ocean, as well as an international
geological-geophysical atlas of the Pacific Ocean. There is a need for a
detailed study of uplifts and downwarps of the ocean floor and Pacific Ocean
abyssal basins. It is necessary to clarify the principal patterns of sub-
marine volcanism and formation of minerals associated with it. Tectonic,
morphotectonic, petrochemical and geochemical regionalization of the Pacific
Ocean must be carried out. There must be much additional study of the condi-
tions for formation and patterns of distribution of deposits of petroleum and

and gas, ferromanganese nodules, metal-bearing sediments, phosphorites and placer minerals. In carrying out geological-geophysical work there should be a combination of regional investigations along individual profiles and geo-traverses with detailed investigations in polygons. Work must continue on the improvement of geophysical and geological apparatus and equipment for marine investigations. A conference on the coordination of this work must be held at least once each three years.
[180-5303]

STUDYING ELASTIC WAVE PROPAGATION VELOCITIES IN DIFFRACTIONAL TRANSFORMATION OF SEISMIC RECORDS

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[Abstract] It is important and necessary to perfect methods for studying velocities in constructing deep seismic sections by the diffractional trans-formation technique. Only by the summing of common deep point seismograms obtained at different times and selecting optimum kinematic corrections does the method have a high geological effectiveness. Velocities can be deter-mined only by the processing of materials from multiple profiling; rigorous and full solution of the problem of studying velocities within the framework of diffractional transformation in fact requires the processing of areal data from multiple observations. This is because in processing real field records a determination of the configuration and position of discontinuities requires field reconnaissance and only by multiple profiling can there be an un-conditional study of elastic wave propagation velocities. On the basis of the examples presented in this article it is shown that in diffractional transformation velocities are computed with a greater accuracy than in the common deep point method. The parameters of the field work method employed, the length of the processing base used and the algorithm outlined in the article made it possible to compute velocities with an error of less than 5%. This fully meets the required accuracy for petroleum and gas exploration work. Velocity analysis in diffractional transformation is intended mainly for choosing the optimum parameters for constructing the deep section but the velocity relationships can also be used in evaluating the lithological change in the deposits. In order to increase accuracy in determining velocities and seismic constructions it is most important to increase the length of the observation base. However, the formulated algorithm must be improved in order to reduce the time expenditure in computing velocities. It is stressed that the study of velocities in the diffractional transformation method is only beginning and many problems remain unclear. Figures 7; references: 5 Russian.
[180-5303]

MODERN RELIEF, MESOZOIC GRANITOID MAGMATISM AND GRAVITY FIELD IN SOUTHERN
FAR EAST REGION

REYNLIB, E. L., Dal'geologiya Production Association, Khabarovsk

[Abstract] Regions of extensive development of Mesozoic granitoid magmatism
in the Far East are characterized by positive relief forms and regional
gravity minima. The interrelationships of the gravity field, granitoid
magmatism and relief have been considered repeatedly, but since much remains
unclear the author has completely reviewed this problem with all the most
recently published data taken into account. As a point of departure for
regional analysis use was made of small-scale geological and gravimetric maps,
a map of averaged relief and the results of a quantitative interpretation of
gravity anomalies. In the gravity field of the southern Far East there are
two extensive deep minima associated with the main mountain structures of the
region--Badzhalo-Taykanskaya mountain system and the Sikhote-Alin' Range.
Figure 1 illustrates the averaged relief, gravity field and distribution
of intrusive-dome structures of the Sikhote-Alin;' Fig. 2 shows the correspond-
ing information for the Badzhalo-Taykanskaya mountain system; Tables 1 and 2
list the characteristics of intrusive-dome structures determined on the basis
of gravimetric and morphometric data for these two systems. These fundamental
data are analyzed, followed by discussion of granitization and relief, Late
Mesozoic granites and modern relief. It is concluded that the principal
factor involved in the initial uplifting of topographic relief of the principal
structures in the southern Far East with widely manifested Late Mesozoic
granitoid magmatism is the joint effect of a reduction in the density of matter
as a result of heating of the upper mantle and granitization of the earth's
crust. The regional arched uplifts were probably caused by heating and re-
duction in the density of matter in the upper mantle. Unlike these first-
order structures, second-order (intrusive-dome) structures are the result of
the granitization and batholith-formation processes. In turn, the initial
uplifting predetermined the development of compensatory regional negative
relief forms. The mountain-forming mechanism described in this article plays
an important role in the forming of topographic relief, but is not the only
one possible. Figures 4, tables 3; references: 30 Russian.
[180-5303]

ALL-UNION SEMINAR-SCHOOL ON GEOELECTRIC RESEARCH

BERDICHEVSKIY, M. N., BEZRUK, I. A., VAN'YAN, L. L., VOLKOV, Yu. M.,
DMITRIYEV, V. I. and ZHDANOV, M. S.

[Abstract] The 6th All-Union Seminar-School on Electromagnetic Sounding was
held in Baku during the period 1-15 October 1981; it was attended by 250
persons from 89 organizations. A series of lectures was presented by leading
authorities in the field. The following seminars were held: Methods for
Structural Electric Prospecting; Geoelectric Models of Principal Geoelectric
Provinces of USSR; Electric Prospecting With Powerful Current Sources; Direct
Problems in Geoelectricity; Inverse Problems in Geoelectricity; Processing of
Magnetotelluric Observations; Practical Results of Work in the Field of Geo-
electricity. A total of 177 communications were presented at the seminars.
Some of the achievements in this field during recent years have been the
following: creation and widespread adoption of digital apparatus for the
registry of fast variations of the natural electromagnetic field and non-
stationary signals excited by artificial sources; development of powerful
field sources (MHD generators, gas turbine apparatus; development of methods
for the automatic analysis of observations (spectral analysis and others);
development of a mathematical approach for solving direct problems in geo-
electricity (both two- and three-dimensional); development of algorithms for
solution of some two-dimensional inverse problems; creation of an archives
of standard geoelectric models; development of programs for the processing of
electric processing data; creation of experimental methods for magnetotelluric
sounding; use of geoelectric methods for studying the structure of a great
number of petroleum and gas regions in the USSR; successful work in studying
electromagnetic phenomena accompanying the process of earthquake preparation.
Among the goals of the future are the following: acceleration of the develop-
ment of electric prospecting methods oriented at studying the physical prop-
erties of rocks in combination with detailed seismic prospecting work; need
for studying crustal and mantle conducting zones; broader development of sea
electric prospecting work over the area of the Caspian Sea in combination
with other geophysical methods; acceleration of standard production of sea
geoelectric apparatus; initiation of planned study of geoelectric section of
world ocean; broadening of geoelectric research using powerful artificial
field sources; broadening of work for studying electromagnetic precursors of
earthquakes; acceleration of development of digital apparatus for deep geo-
electric investigations; high-latitude experiments for clarifying structure
of magnetotelluric field; development of a standard system for the processing
and interpretation of deep geoelectric observations.
[167-5303]

STANDARDIZING FREQUENCY CHARACTERISTICS OF TYPE-C LONG-PERIOD SEISMOGRAPHS

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imeni O. Yu. Shmidt, USSR Academy of Sciences

[Abstract] Since long-period body and surface waves from strong earthquakes
give valuable data on the earth's deep structure it is essential to have
seismological instruments with long-period channels having a band with reliable
registry for periods from several to hundreds of seconds. The necessary
seismometers and galvanometers were developed in the USSR and the GDR in the
late 1960's. The article gives the principal parameters of the channels
(modifications SD-1 and SD-2 (USSR) and SJ-1/L (GDR) for the instrumentation
discussed in this article having "type C" characteristics. Due to the
peculiarities of the background of long-period noise at individual seismic
stations use has been made of a wide range of magnifications in the trans-
mission band of "type C" characteristics. This has dictated the need for
standardizing the frequency characteristics regardless of magnification.
Solution of this problem is presented. The several different standardization
methods used in seismometric observations with galvanometric registry are
reviewed. Stress is on the "identity transformation of parameters method"
for standardizing SD-1 frequency characteristics. A series of limitations
is given relative to the regulation of a number of parameters of seismometers
and galvanometers. It is shown that the identity transformation method can
be used only in the limited range $T_g \simeq$ 105-115 sec. The specific procedures
for approximate standardization of SD-1 channels are outlined. The results
were highly accurate and are recommended for adoption in standard seismometric
observations. Figures 2, tables 3; references 12: 11 Russian, 1 Western.
[167-5303]

DISCRIMINATING ARRIVALS OF MULTIPLE EXCHANGE WAVES IN INITIAL PART OF RECORD
OF DISTANT EARTHQUAKES

SPIRTUS, V. B., Geophysical Institute, Ukrainian Academy of Sciences

[Abstract] In the structure of the initial part of the record of distant
earthquakes exchange, multiple and possibly lateral and scattered surface
waves are superposed on the primary longitudinal wave. It is the difficulty
in discriminating and identifying different phases in the analysis of the

physical validity of the transmitted exchange waves method which constitute
the main obstacle in using distant earthquakes for studying the earth's crust.
In this article, in the example of several earthquakes registered at "Simfero-
pol'" seismic station, the author demonstrates that it is possible to corre-
late certain characteristics of the records for discriminating stable phases
and a simple means is outlined for using polarization characteristics for
analyzing motion of a medium particle in the horizontal plane. Procedures
of the integral type are not used. Local perturbations of directivity and
ellipticity of the trajectory of motion are investigated. The proposed method
makes possible separation of interfering signals in short segments of the
record, thereby enhancing resolution of polarization analysis. All this re-
quires selection of an optimum model of the medium and formulation of an
appropriate algorithm. The search for this optimum variant can be carried
out within a definite class of models, such as horizontally layered, gradient-
block and others. The author feels that there is a particular need for
developing an algorithm for layers lying in unconformity on one another and
has made a start on this task. Among the other contributions is an algorithm
for computing the arrival times of different types of waves for a nonhorizon-
tally layered medium. Computations and comparison with observational data
are used in constructing a preliminary model of the medium for the neighbor-
hood of Simferopol'. Figures 5, tables 2; references 10: 7 Russian 3 Western.
[167-5303]

TRANSVERSE WAVE FROM NONDIRECTIONAL SOURCE IN INHOMOGENEOUS ELASTIC MEDIUM

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Association, USSR Geology Ministry

[Abstract] The fields excited by nondirectional sources, such as used in
seismic prospecting, frequently contain strong transverse waves. The article
is devoted to an investigation of one of the possible mechanisms of generation
of transverse waves: their genesis at the source due to the gradient character
of the medium. The analysis is based on the asymptotic formulas derived by
the author in earlier work: DOKL. AN SSSR, Vol 219, No 4, 1974; VOPROSY
DINAMICKESKOY TEORII RASPROSTRANENIYA SEYMICHESKIKH VOLN, Vol 15, Leningrad,
Nauka, 1975. The mathematical model used for the wave process is the problem
of movements of an isotropic medium under the influence of an instantaneous
point source of the center of expansion type. Within the framework of this
model asymptotic formulas are derived which describe a transverse wave excited
in a medium with a smooth gradient with a point pressure center. The amplitude,
polarization, spectral and energy characteristics of the transverse and longi-
tudinal waves are compared and theoretical seismograms are constructed. The
presented theory makes clear how a rather strong transverse wave is propagated

from a nondirectional source. Despite the small fraction of energy carried
by the transverse wave from the source, its amplitude in some directions can
be comparable with the amplitude of the longitudinal wave. Transverse waves
have X- and Z- components in a medium which is vertically inhomogeneous rela-
tive to Z. Finally, a transverse wave generated under these conditions has
lower predominant frequencies than a longitudinal wave. Figures 6; refer-
ences: 8 Russian.
[167-5303]

AChF-3 PENDULUM ASTRONOMICAL CLOCK AS PRECISE GRAVIMETRIC INSTRUMENT

KOLOSNITSYN, N. I.

[Abstract] A pendulum clock can be employed in observing slowly changing
variations of gravity caused by the tidal effect of the moon and sun. The
possibility for such measurements was substantially enhanced by the develop-
ment of the exceedingly precise AChF-3 astronomical clock by F. M. Fedchenko.
The article evaluates these possibilities on the basis of actual gravity
measurements. In the AChF-3 pendulum clock many of the factors which in-
fluence gravity measurements have been eliminated: the pendulum is sealed,
in a vacuum, the oscillations occur continuously at a stable level in an
autooscillation regime. The measurement accuracy is three orders of magni-
tude higher than in ordinary pendulum instruments. The accuracy in dis-
criminating earth tides and slowly changing gravity changes with the AChF-3
is potentially higher that for any ballistic gravimeter. The AChF-3 has
proven itself as the world's best mechanical clock. The high accuracy of its
clock rate is probably attributable to the isochronicity of oscillations
attained by use of an original suspension. The first use of the AChF-3 for
observing tidal changes of the gravity field was in 1968 and 1969. There
were two 3-month series of continuous observations of clock rate with an
interval between readings of 2 hours; the accuracy in detecting tides was
very high. The collected data were later employed in a spectral analysis for
discriminating diurnal (0_1, K_1) and semidiurnal (N_2, M_2, S_2) tidal waves.
With respect to the accuracy in discriminating short-period tides the AChF-3
is inferior to the GS "Askania" gravimeters, but is superior to them with
respect to null-point drift. In reality, in present form the AChF-3 is not
adapted for gravimetric measurements. The electromechanical system for
registering the period of oscillations is imperfect (there is a mechanical
contact), it is unautomated and the clock is not thermostated. The influence
of temperature has not been taken into account in processing the results. A
changeover to a contactless system for the registry of period, elimination of
subjective errors by automation, creation of a thermostat, insulation from
vibrations and microseisms will increase the accuracy in measuring gravity
fields by not less than an order of magnitude. With respect to long-period
tides, their registry is not possible with the GS due to the null-poin drift

and therefore the AChF-3 should be used for this purpose. The instrument can also be employed for measuring nontidal changes of the gravity field caused by vertical movements of individual regions or possible expansion of the earth. References 11: 10 Russian, 1 Western.
[155-5303]

TECTONICS OF SEDIMENTARY COVER OF PARTS OF SEA OF JAPAN ADJACENT TO HONSHU

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[Abstract] This is a detailed description of the sedimentary cover of the southern and eastern parts of the Sea of Japan, which takes in the shelf of Honshu, its slope, the deep Yamato and Tsushima Basins and submarine rises (ridges and banks). This is a very well-studied area. Seismic, magnetometric and gravimetric regional profiles were constructed. Figure 1 in the text is a bathymetric map of the Sea of Japan, which makes clear how complex the bottom relief is in the studied region. Figure 2 is a map of the thickness of the sedimentary cover in the area involved. A sedimentary cover extends over virtually the entire area; four strata can be defined, varying in age from the Middle Miocene to the Quaternary. This cover consists of unconsolidated diatomaceous oozes, clays, silts, and poorly consolidated diatomites. As shown in Fig. 1, five profiles run transversely across the considered region; sediments and structures along each of these profiles are examined in detail. The paleogeography is examined in depth, supported by a peleogeographic map (Fig. 5). It appears that deep basins were formed in the Middle Miocene and the modern configurations of the Sea of Japan were formed in the Late Quaternary. Figures 5; references 21: 8 Russian, 13 Western.
[185-5303]

RED SEA RIFT AND ITS ROLE IN DISTRIBUTION OF FERROMANGANESE MINERALIZATION

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[Abstract] The materials in this article were derived from an analysis of the considerable volume of geological data already collected in the neighborhood of the Red Sea rift and published in the literature. Figure 1 is a map

of the distribution of ferromanganese mineralization along the western margin
of the Red Sea rift; Figure 2 is a geomorphological diagram of the same area.
The materials reflected in these two figures are discussed in detail, serving
as a point of departure of an in-depth examination of all published data on
ferromanganese mineralization in the considered area. It appears that in all
regions where Fe-Mn and multicomponent mineralization is found the deposits
are localized in the most active dilatation zones. The ore formation occurred
at different times from the Middle Pleistocene to the Holocene. This ore
formation is still continuing in the axial trough of the Red Sea rift. The
spatial distribution of wedgelike depressions, which correspond to ore fields,
conforms rigorously to faults with a meridional strike, whereas the key role
in the localization of steeply dipping ore bodies and vein formations is
played by faults of a northwesterly strike. The coincidence of ore bodies
with dike fields can be used in prediction, especially since dikes are easily
detected by magnetic prospecting. Many of the observed associations can be
used in predicting Fe-Mn mineralization in the Red Sea and other rift zones.
The presence of dilatational structures, breaking the continuity of rocks of
Pleistocene age on the western margin of the Red Sea rift, is evidence of the
recentness of the tectonic movements actively manifested not only in its
axial zone, but also in marginal parts of the rift valley. Figures 4;
references 20: 17 Russian, 3 Western.
[185-5303]

TECTONIC STRUCTURE OF HESS RISE IN PACIFIC OCEAN (ACCORDING TO DEEP SEISMIC
PROFILING-REFLECTED WAVES METHOD DATA)

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imeni P. O. Shirshov, USSR Academy of Sciences; Geological Institute, USSR
Academy of Sciences

[Abstract] The authors give the results of deep seismic profiling by the
reflected waves method carried out along a profile across the southern part
of Hess Rise in the Pacific Ocean; the location of this profile, with a
length of 300 km, is plotted on a map (Fig. 1). Elastic waves were excited
by a pneumatic sound source with a pressure $150 \cdot 10^5$ Pa at a depth of 25-30 m;
reception of reflected signals was with a towed array (24 channels, 2000 m in
length); the work was done while the ship was proceeding on course at a
speed of 5 knots; the shot interval was 50 m. The characteristics of the
seismic profile and the structures detected along it are described in detail.
The area was found to have an anomalously thick crustal structure (up to 15 km
or more). The peculiarities of the structural forms of the discontinuities,
the detected symmetry of structure and flexural bending of the Moho beneath
the Hess Rise can be a result of isostatic subsidence due to loading of the
volcanic uplift. The Hess Rise can be interpreted as a volcanic mass whose
volcanic nature is confirmed by the detection of alkaline basalts by abyssal

drilling and dredging.. The symmetry in the structure of the studied sector, the presence of a central dome surrounded by depressions and then by zones of dislocations probably is indicative of an enormous caldera. The covering of the basaltic basement by sediments is evidence of the formation of the volcanic mass of the Hess Rise prior to sedimentation. The age of its formation is Albian (100-110 million years), which together with an analysis of the thickness and structure of the crustal layers, paleodepths, quiet Mesozoic magnetic field, subaerial alkaline and subalkaline basaltic and calcareous (possibly coral) structures on the peaks of the volcanic rises makes it possible to assume that the Hess Rise was formed in the Albian in the equatorial zone of the Pacific Ocean in a region of triple juncture of boundaries of lithospheric plates. Figures 5; references 23: 22 Russian, 1 Western.
[185-5303]

DYNAMIC MODEL OF SEISMIC ANISOTROPY FORMATION IN EARTH'S UPPER MANTLE

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[Abstract] Many hypotheses now exist concerning the mechanisms of formation of seismic anisotropy of the upper mantle beneath the oceans, but all are encumbered by significant shortcomings. Accordingly, the authors have formulated a new dynamic model of the formation of upper mantle seismic anisotropy under the oceans. The model takes into account the movement of noninteracting solid ellipsoidal anisotropic particles in a flow of viscous Newtonian fluid. It is required that an evaluation be made of the temporal change in the type of symmetry of the medium and also the temporal behavior of the anisotropy coefficient for such a medium. The proposed model can be regarded as a first approximation to real processes in the earth's upper mantle. In this model it is assumed that the base of the asthenosphere is fixed and that the lithospheric plate moving at a stipulated rate along the surface of an asthenospheric layer with a thickness $H \sim 200$ km with a constant viscosity (or a viscosity slightly dependent on depth) creates a gradient of the rate of plastic deformations almost not dependent on depth. It is postulated that the steady process of flow of rocks making up the upper mantle is described by a linear law of Newtonian flow. The movement of the mineral aggregates in the surrounding medium is represented as the movement of solid ellipsoidal particles in a slowly deforming viscous Newtonian fluid. A formula is derived for the elastic modulus of the medium. An expression is given for the velocities of elastic waves in an anisotopic medium and also for the anisotropy coefficient for a particular moment in time. On the basis of this model and the derived formulas it is also possible to make an approach to solution of the inverse problem. Figures 3, tables 1; references 11: 4 Russian, 7 Western.
[189-5303]

SCATTERING AND ABSORPTION EFFECTS FOR LONGITUDINAL WAVES IN EARTH'S CRUST

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[Abstract] Absorption and scattering of seismic energy are the most probably
causes of attenuation of longitudinal seismic waves in the crust and upper
mantle. However, at present efforts at formulating theories of absorption
have failed to give satisfactory agreement with experimental data. The
authors have clarified the relationship between absorption and scattering
effects on the basis of an experimental evaluation of the α_{ab} and α_{scat}
parameters (α_{ab} is the absorption energy coefficient, α_{scat} is the
full scattering coefficient, determined as the relative attenuation of the
energy flux of a body wave per unit length of path due to scattering in
different directions). The concept of a "seismic scattering coefficent"
$\alpha_{s\ scat}$ is introduced for evaluating energy losses due to scattering of
P waves. This coefficient can be found from observations at a group of seismic
stations ($\alpha_{s\ scat}$ is determined as the ratio of the energy flux of the
fluctuating component δJ to the energy flux of the smooth component J_0 of
the P wave field through a sector of an observation surface of the area D
and to the distance s traveled by the wave in the scattering medium).
Expressions are derived for the total energy flux $J_0 + \delta J$ and for the re-
lationship between $\alpha_{s\ scat}$ and the turbidity coefficient g. Since $\alpha_{s\ scat}$
per se does not give a full idea concerning the total losses due to scattering
it was necessary to derive further formulas to correct this deficiency. The
derived formulas define the relationship between the coefficients α_{scat} and
$\alpha_{s\ scat}$. On the basis of a further examination of this ratio an expression
is derived for evaluating the full scattering coefficient α_{scat}. In an
example it is shown that in the case of propagation of P waves in the crust
in the frequency band 1.0-50 Hz most of the losses in the propagation of P
waves are related to scattering effects. Figures 3; references 9: 7 Russian,
2 Western.
[189-5303]

COMPARATIVE CHARACTERISTICS OF REACTION OF GROUND WATER LEVEL AND YIELD TO PREPARATION OF EARTHQUAKES

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[Abstract] Many studies have been made concerning the reaction of the ground water table to an impending earthquake. Prior to an earthquake of a given class there is always a drop of level with its subsequent restoration immediately before and after a tremor. The time interval between onset of the level drop and the tremor is usually 3-7 days and even prior to the strongest earthquake the drop does not exceed 10-15 cm. This phenomenon has been observed in many parts of the world. Much less is known concerning the reaction of the ground water yield to an impending earthquake. This article describes observations of change in yield of ground water under these conditions in the seismically active Sakhalin-Kurile region. Such observations were made on Shikotan, kunashir, Iturup and Sakhalin Islands. The influence of other factors, such as changes in atmospheric pressure and heavy rains, was taken into account. The data clearly indicate a rigorous pattern of change in water yield in relation to earthquakes. Several days before a seismic tremor (not more than 10) the water yield increases, but immediately prior to a tremor or immediately thereafter it decreases sharply to the background level. This agrees with earlier findings. Changes in level and yield of ground water during the period of an impending earthquake occur synchronously, but in antiphase (an increase in yield is accompanied by a decrease in level and vice versa). These phenomena cannot be attributed to a change in water head. The most probably reason for the decrease in water level is expansion of the rocks in the near-surface layer, accompanied by an increase in their fissuring and porosity. The same factor is responsible for the change in water yield: a change in the rock permeability factor. An increase in fissuring and porosity should inevitably be accompanied by an increase in the permeability factor and therefore an increase in the inflow of water into the borehole or its yield. Figures 1; references: 5 Russian.
[189-5303]

MODELING INDUCTION IN CONDUCTING EARTH IN STUDY OF POLAR ELECTROJET DYNAMICS

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[Abstract] The position and motion of auroral electrojets must be known in
investigations of many auroral zone geophysical phenomena. It is essential
to separate the measured magnetic field variation into fields created by
external currents and currents induced in a conducting earth. The most
commonly used method for taking induction in the earth into account is
inadequate for investigations of electrojets. A more precise method involves
use of an idealized conductivity model in which the crust is considered an
insulator and the mantle is considered an ideal conductor. In order to
examine the validity of such an approach the author computes the field of an
electrojet creating a baylike disturbance over a medium with a finite con-
ductivity and attempts to ascertain what errors in interpretation of magnetic
field variations can arise from the use of an idealized conductivity model.
The computations indicate that the finite conductivity of the medium leads
to the appearance of a dependence of the induction coefficient not only on
distance to the source, but also on the phase of the bay. This dependence
on time can be taken into account by a model of an ideal conductor, the depth
to which increases with time. Such a model makes it possible to take induc-
tion in the real earth into account, but at the same time the increase in the
"effective" thickness of the insulator with time must be taken into account.
In this case the simultaneous use of profiles of the Z and H components makes
it possible to determine the parameters even of a distant electrojet.
Figures 2; references 8: 2 Russian, 6 Western.
[145-5303]

CORRELATION BETWEEN GEOMAGNETIC VARIATIONS IN POLAR CAP AND INTERPLANETARY
MAGNETIC FIELD IN SOLAR ACTIVITY CYCLE

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[Abstract] The regression relationships between the components of the inter-
planetary magnetic field (IMF) and the geomagnetic field components in the
north polar cap in the summers of 1965, 1966 and 1968 have been analyzed in
earlier studies. A simple comparison of the results of these investigations
gives no direct answer to the question as to whether there are cyclic varia-
tions in the intensity or configuration of the equivalent current systems
controlled by IMF components. The author has sought to answer this question.
A statistical analysis was made of mean hourly geomagnetic data for Thule
and Godhavn for the four summer months of six years (1965-1970). Three field
components (H, D. Z) were transformed to corrected geomagnetic components
(X', Y', Z') with allowance for the secular variation. For these same
periods data were selected on the IMF components (B_x, B_y, B_z) in a solar-
magnetospheric coordinate system and the data were subjected to multi-
dimensional regression analysis both separately for the summer seasons of
each year and for all six summer seasons. The analysis revealed that the
macroscale characteristics and intensity of the DP_2, DP_3 and DP_4 current
systems do not change with an increase in solar activity during the 20th
cycle. It is possible that the integral conductivity of the polar ionosphere
also remains unchanged or its changes are compensated by the electric field.
The values of the regression coefficients computed from the sum of days of
several summer seasons reflect better the correlation between surface varia-
tions and the IMF; therefore, for constructing correlation models of the geo-
magnetic field in the polar caps it is necessary to have a greater body of
statistics than provided by data for a single year. Figures 3; references
6: 4 Russian, 2 Western.
[145-5303]

AURORAL DISTRIBUTION

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of Sciences

[Abstract] The distribution of auroras is essentially dependent on the
direction of the interplanetary magnetic field (IMF). With a southerly
direction of the IMF auroras are observed within the oval and are not observed
in the polar cap; with a northerly direction of the IMF auroras disappear
from the oval but appear in the polar cap. The author proposes an explana-
tion for these phenomena. It is noted that a necessary condition for genera-
tion of auroras is the appearance of the arc of a longitudinal electric field
in the magnetosphere over the generation region. Such a field can arise
only with adequately low concentrations of cold plasma n_m (when there is a
great quantity of cold plasma in the magnetosphere the longitudinal electric
field is short-circuited). The distribution of cold plasma in the high-
latitude magnetosphere is essentially dependent on the nature of magnetospheric
convection. The complex of interrelated phenomena is described step-by-step.
It can be postulated that the probability of the appearance of auroras is in-
versely proportional to the concentration n_m of cold plasma. In the region
of open magnetic lines of force or where the lines are drawn far into the
tail of the magnetosphere the n_m value is determined by the plasma concentra-
tion at the maximum of the ionospheric F-region. The tongue of increase con-
centration observed in the unilluminated polar cap when the IMF has a southerly
direction leads to an increase in the concentration of cold plasma in the
magnetosphere and disappearance of auroras from the polar cap. With a northerly
direction of the IMF the region of an increased concentration in the ionosphere
and magnetosphere has the form of a ring framing the polar cap. In this case
auroras appear in the polar cap and disappear from the oval region. Figures 1;
references 11: 4 Russian, 7 Western.
[145-5303]

SIX-MINUTE PULSATIONS OF STRATOSPHERIC ELECTRON FLUX

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[Abstract] During 1977-1979 the authors made measurements of the vertical
flux of electrons in the energy range 50-500 KeV at Alma-Ata, Moscow and

Apatity (λ= 36.4°, 50.8° and 63.6° respectively). The radiation detectors used were SBT-9 end-window counters. Electrons of the required energies were discriminated by the difference method with use of deflecting magnets. The time resolution was 1 minute. Instruments were carried aloft in standard balloons which could rise to 35 km and which flew for 2-3 hours. The authors conclude on the basis of the analyzed data that there is an agreement of the periods of pulsations of electron fluxes in the different years, indicating a stability of the mechanism causing them during the indicated time interval. Since the detected effect is localized in the auroral zone it is natural to assume that it is related to the leakage of trapped radiation, as is frequently observed in this region. The principal element in the temporal structure of electron leakage is bays with a duration of about 60 minutes coinciding with negative bays of the H-component of the magnetic field. The period of the characteristic oscillations of the magnetosphere for latitudes about 70° is about 400 sec; this coincides with the period of the detected pulsations. The magnetic field pulsations in turn induce pulsations of the flux of leaking particles, rather convincing evidence of a correlation between these phenomena. Figures 1; references: 6 Russian.
[145-5303]

MODELING PROCESS OF PROPAGATION OF VLF WAVES IN EARTH'S MAGNETOSPHERE

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[Abstract] Various attempts have been made in the past to compute the trajectories of VLF waves in the magnetosphere. The computations made by the authors of this paper differ from earlier work in the following ways: in the choice of the model of distribution of electron concentration N_e, with allowance for the dependence on the index of geomagnetic activity; by the introduction of additional operations for taking into account the three-dimensionality of the trajectories and the presence of points of wave reflection or their transformation into the electrostatic mode; in the analysis of the factors involved in change in the polarization and amplitude of the electric and magnetic components of the VLF waves. The character of the computations presented here constitute essentially a modeling of the process of propagation of VLF waves in the magnetosphere. The authors give a detailed exposition of the ways in which their computations differ from those used by other authors, particularly: 1) A new model of the distribution of the electron (N_e) and ion (N_i) concentrations in the magnetosphere; 2) Three-dimensional computations made by the introduction of a third space coordinate φ (azimuth angle), the angle ε between the wave vector k and the meridional plane, and by stipulation of a longitude dependence of the electron and ion concentrations;

3) The basis for writing the algorithm for computing the amplitude character-
istics was an equation transformed from the equation for the energy of an
electromagnetic wave in plasma. Specific results were obtained with respect
to determination of the trajectories of VLF waves and the pertinent amplitude
factors. Emphasis is on the amplitude factors because until now they have
not been taken into account in the analysis of experimental data. A number
of factors, such as an increase in the amplitude of the signal of VLF sources
in a magnetically conjugate region with an increase in geomagnetic activity
by a factor of 2-3, the decrease in the amplitude of VLF noise in the
plasmapause region, and also the zone of detection of plasmaspheric noise,
can be explained on the basis of the computations presented in this article.
Figures 5; references 22: 14 Russian, 8 Western.
[145-5303]

INVESTIGATING STATISTICAL PROPERTIES OF RELATIONSHIP BETWEEN INTERPLANETARY
AND GEOMAGNETIC FIELDS BY MULTIPLE COHERENCE FUNCTIONS METHOD

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[Abstract] The linear regression method has proven highly effective in
statistical investigations and made possible a considerable clarification of
the relationship between variations of the interplanetary magnetic field and
the geomagnetic field. However, the authors felt it necessary to confirm
the physical significance of the results. This has been done by studying
the dynamics of individual events or series of events, but can also be done
by broadening the statistical analysis methods employed, especially by
application of the multiple coherence functions method. It was possible to
determine the intervals of most stable correlation. The influence of change
in sign of the azimuthal component of the interplanetary field on the correla-
tion spectrum is evaluated. It is demonstrated that the multiple coherence
functions method is entirely valid and effective for investigating the inter-
relationship between the interplanetary magnetic field and terrestrial varia-
tions. The most stable range of interrelationship was found to be in periods
of $\sim$ 12 and $\sim$ 4 hours. It was also possible to construct the equivalent
current systems responsible for variations in the main periods in the in-
vestigated time series. The construction and analysis of such equivalent
current systems can be useful for many practical problems such as for deep
sounding, when it is desirable to know the distribution of currents in specific
periods in which sounding is carried out, or for the separation of fields
when artificially modifying ionospheric sources. Figures 3; references 10:
6 Russian, 4 Western.
[145-5303]

TWO-FREQUENCY RADAR OBSERVATIONS IN 'ZARNITSA-2' EXPERIMENT

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[Abstract] The "Zarnitsa-2" experiment is a continuation of a series of
experiments for study of the interaction between a beam of electrons injected
from a rocket and the ionosphere. One of the objectives of the "Zarnitsa-2"
experiment was a study of the properties of the radio emission source whose
origin is related to ignition of a beam-plasma discharge near the rocket.
Radar observation data are of particular value: they can be used in simultan-
eous monitoring of the dynamics of both the radio emission and the region of
ionospheric plasma disturbed at the time of injection. The injection of
electrons from abroad a rocket was in impulses with a duration of 0.8 and
0.08 sec separated by a pause of 0.8 sec. The plasma generator operated during
the 236th-267th second of flight. The injected electrons had energies 9.2 KeV
and 7.2 KeV. The observations were made with a coherent two-frequency radar
outfit which consists of two radars having working frequencies of 22.5 MHz
and 33.8 MHz, pulse duration 20 μ sec, receiver passband 250 KHz, receiver
response 3.5 μV, signal-to-noise ratio 2:1. During the experiment the
signals reflected from the target and the characteristic radio emission of the
ionosphere disturbed by the beam were registered at the two frequencies.
Various types of radio reflections were discriminated and analyzed. The
article emphasizes the analysis of data on radio reflection from the circum-
rocket region as a function of altitude. Formulas were derived for evaluating
the effective surface of scattering by the reflecting region and estimating
linear dimensions of the region of reflection, as well as the rate of expan-
sion of the reflecting region along the radar line of sight, determined from
the change in the phase of the reflected signal. At the time of appearance
of the radio emission there was a sharp change in the amplitude and phase of
the reflected signal; this confirms the localization of the radio emission
source in the reflection region near the rocket. Figures 4; references 11:
10 Russian, 1 Western.
[145-5303]

INFLUENCE OF IONOSPHERIC PLASMA ON GENERAL CIRCULATION IN UPPER ATMOSPHERE.
PART 2

KHANTADZE, A. G. and GVELESIANI, A. I., Geophysical Institute, Georgian
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[Abstract] In an earlier (GEOMAGNETIZM I AERONOMIYA, 21, 988, 1981) the authors
demonstrated theoretically the possibility of the existence of macroscale
eddies and general circulation of the atmosphere caused by the presence of
horizontal pressure gradients, Coriolis force and electromagnetic forces in
the ionosphere. An important role of electromagnetic effects in the general
circulation of winds in the ionosphere at different levels was revealed. This
new article, essentially a continuation of the first, gives numerical computa-
tions of a system of horizontal winds in a spherical coordinate system.
Figures 2 and 3 show the global system of winds in the entire thickness of
the ionosphere from 90 to 400 km for the midnight summer and winter ionospheres
in both hemispheres. As shown in Fig. 2, in the summer northern hemisphere
between 15 and -15° there is a zone of wind convergence, between -15 and -30°
--a zone of divergence, and between -60 and -90°--a zone of wind convergence.
Figure 3 shows that in the winter northern hemisphere a convergence zone is
situated between 45 and 15° and a divergence zone between 15 and -15°. There
are also macroscale eddies taking in the ionospheric region above 210 km,
where there is a disruption of wind geostrophicity. In the daytime ionosphere
the vertical scale of the eddy movements doubles since in this case disruption
of wind geostrophicity occurs in the lower layers (above 100 km). Figure 4
shows that for the midnight ionosphere there are eddy zones of wind flows near
the equatorial latitudes (anomalous region) and an anomalous high-latitude
region ($\sim$ 70°). The analytical and numerical computations made here show
that in the pattern of general circulation in the ionosphere there are both
macroscale eddy formations and zones of wind convergence and divergence leading
to the generation of ascending and descending air flows. All this leads to
both the transport and redistribution of ionospheric plasma in both vertical
and horizontal directions. A study of three-dimensional ionospheric circula-
tion makes it possible to detect zones of anomalously increased ionization
and discovery of increased ionization at different longitudes and latitudes
at a global scale makes it possible to judge the presence of zones of conver-
gence and divergence of winds and ascending and descending movements. Figures
4; references 5: 4 Russian, 1 Western.
[145-5303]

USING INCOHERENT SCATTERING DATA IN DETERMINING AERONOMIC PARAMETERS AT
F-2REGION ALTITUDES. ANNUAL VARIATIONS OF ATOMIC OXYGEN

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State Committee on Hydrometeorology and Environmental Monitoring

[Abstract] The incoherent scattering method makes it possible to determine
many parameters of ionospheric plasma. The measured values provide informa-
tion on the state of the neutral atmosphere, intensity of solar ionizing
radiation, velocity of tropospheric winds and strength of electric fields.
Conclusions can then be drawn concerning the values of aeronomic parameters,
such as on the concentration of atomic oxygen in the upper atmosphere. The
method proposed here on this basis differs fundamentally from the known
method for determining [0] by solving the heat balance equation (D. A. Alcayde,
et al., JGR, 76, 7814, 1971). The materials presented here, illustrated in
examples, reveal the presence of well-expressed seasonal and semiannual varia-
tions. The amplitude of the seasonal variations is 1.4-1.8 and the amplitude
of the semiannual variations is about 3. During summer for days with close
values of the indices of solar and geomagnetic activity there are appreciable
differences in the concentration of atomic oxygen despite close model [0]
values. This indicates the possibility of rapid changes in the composition
of the upper atmosphere during summer and the limitations on modern models
of the thermosphere. It is clear that it is necessary to take into account
additional factors (besides solar and geomagnetic activity) exerting an
appreciable influence on the state of the thermosphere. Figures 2, tables 3;
references 22: 19 Russian, 3 Western.
[145-5303]

ONE TYPE OF PHASE ANOMALIES OF VLF SIGNALS ON AURORAL PATHS

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[Abstract] The results of phase measurements of VLF signals radiated by
Norwegian stations and received at Apatity over a period of years reveal a
considerable number of cases when anomalous ionization in the lower ionosphere
arises against a virtually calm geophysical background. The duration of VLF
phase variations ranges from several minutes to 0.5-1.0 hour and the value
is $\gtrsim$ 3-6 μ sec; this corresponds to a decrease in the effective altitude of

the ionosphere for VLF by more than 3-4 km. This is illustrated in a particular
case. VLF variations of this type are a quite frequent phenomenon; more than
700 cases were registered during the three years from 1974 through 1976. In
the diurnal variation the maximum of the appearance of phase anomalies falls
in the afternoon hours LT. It was necessary to clarify the source of the
discussed VLF anomalies since it was clear that they were not caused by in-
jections of solar protons or bursts of solar wave radiation. The absence of
significant variations in riometer and magnetic records indicates the small-
ness of fluxes of auroral electrons with energies 1-40 KeV. The analysis
presented here indicates that the most probable cause of the detected
anomalies in the injection of fluxes of electrons of relativistic energies
($\gg$ 200 KeV). Due to the high degree of localization of the regions of in-
jection of relativistic electrons their greatest influence will be on VLF
paths of small and intermediate length (up to 2000-3000 km), oriented in a
latitudinal direction. The fact that the dumping of relativistic electrons
into the earth's atmosphere can occur in the absence of riometric and magnetic
anomalies indicates the existence of potential difficulties in predicting
disruptions of VLF radio communication during periods of injection of such
electrons. Figures 3; references 14: 5 Russian, 9 Western.
[145-5303]

GENERATION OF ACOUSTIC-GRAVITATIONAL WAVES BY AURORAL ELECTROJETS

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[Abstract] The principal mechanism of excitation of acoustic-gravitational
waves in the auroral electrojet is the effect of the ponderomotive force on
the ambient neutral gas and the release of Joule heat in the zone where the
electric current flows. In any such investigation a comparison of the
analytical computations with experimental data is difficult because the real
spatial and temporal structure of the auroral currents is highly complex. It
is seldom that a characteristic quasiperiod can be discriminated; there is
usually a sequence of impulses of different amplitude separated by uneven
intervals and with different durations. Moreover, there are two electrojets
which flow along the auroral oval and their lengths are different. The
currents are directed toward one another (easterly and westerly electrojets).
The author analyzes the excitation of acoustic-gravitational waves by these
two electrojets flowing in opposite directions. This is done for the cases
of both periodic currents and for currents in the form of a series of impulses.
The contributions of the ponderomotive force and Joule heat are examined
separately. Analytical equations are obtained for solution of the problem.
On this basis it is possible to estimate the extent of the region of predomi-
nant effectiveness of wave generation by one factor or another. Computation

formulas are derived for a source harmonic in time and for a source in the form of a series of impulses of different amplitude and duration. The analytical expressions can be used in an analysis of a real ionospheric disturbance. References 6: 2 Russian, 4 Western.
[145-5303]

EXCITATION OF ELECTRIC CURRENTS IN RANGE OF GEOMAGNETIC PULSATIONS BY POWERFUL RADIO EMISSION

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[Abstract] A number of important aspects of the effect exerted on the ionosphere by powerful modulated SW radiation are examined. Such an effect excites nonlinear electric currents in the lower ionosphere at the modulation frequency and these in turn are sources of low-frequency electromagnetic fields. These fields cannot be found without knowing the spatial distribution of the developing nonlinear currents. Accordingly, in this article, for a case when the modulation frequency falls in the range of geomagnetic pulsations, the authors find the spatial distribution of currents with ionospheric inhomogeneity taken into account. The investigated frequency region is interesting because in it the region of generation of currents includes altitudes with the maximum conductivity of ionospheric plasma. Quite strong disturbances can be expected at these frequencies. The problem is formulated as follows: powerful SW radiation modulated in amplitude with a stipulated frequency is vertically incident on the ionosphere. The electron temperature oscillates with the same frequency. The transverse dimension of the region of temperature change is determined by the antenna directional diagram. The longitudinal dimension is highly dependent on modulation frequency. With such a formulation it is demonstrated that when the modulation frequency falls in the range of geomagnetic pulsations there can be disturbances of concentration in the conjugate part of the ionosphere in the other hemisphere and there will be a transfer of plasma from the heating region associated with the external electric field. References 7: 5 Russian, 2 Western.
[145-5303]

NONSTATIONARY PROCESSES DURING DISTURBANCE OF NIGHTTIME POLAR IONOSPHERE
BY RADIO WAVES

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Geophysical Institute, Kola Affiliate, USSR Academy of Sciences

[Abstract] An experimental study was made of the Doppler frequency shift
of a test radio signal reflected from the F region of the nighttime polar
ionosphere which is being modified by powerful radio radiation. A powerful
heating apparatus, located beyond the polar circle in the Monchegorsk region,
operated at a frequency of 3.33 MHz in two regimes (5 minutes of continuous
radiation, 5 minutes pause; 15 minutes radiation, 15 minutes pause). The
effective power of the plane-polarized radiation was about 5 MW. The trans-
mitter registering the test radio waves operated at 3.365 MHz. The radiation
of the heating and test radio waves was from a single point. The test radio
wave reflected from the ionosphere was received 56 km to the south of the
transmitter. An ionosonde was used for checking ionospheric conditions. The
cycle of observations lasted from 0015 to 0415 LT during the period 8-19 Janu-
ary 1981. The Doppler frequency shift of the test radio signal passing through
the disturbed region is examined in detail. Theoretical computations were
made of the effect and there was found to be a good agreement between the
theory and experimental data. Accordingly, the method is effective in study-
ing plasma movements in the F layer of the nighttime polar ionosphere.
Figures 4; references: 9 Russian.
[145-5303]

STRUCTURE OF DAYTIME EQUATORIAL IONOSPHERE

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[Abstract] The altitudinal distribution of both the temperature and concen-
tration of ionospheric plasma over the magnetic equator was analyzed. The
author shows that under daytime conditions the altitudinal distribution of
concentrations and temperatures of charged particles over the magnetic equator,
which in a general case is determined as a minimum by a two-dimensional system

of nonlinear equations--continuity equation, equation of motion, heat balance equation and an equation for the electromagnetic field--can be reduced to solution of the algebraic system of equations derived in this article. The equations are applicable for the altitude range 100-2000 km at the midday hours under quiet geomagnetic conditions for different solar activity levels. This solution requires a minimum number of input parameters. In order to reconstruct the vertical distribution of concentrations and temperatures of charged particles it is necessary to know the date, intensity of the flux of solar radiation, velocity of electrodynamic drift and electron temperature at any one fixed altitude. The computed altitudinal profiles of electron temperature have a maximum near 250 km, which agrees with observational data. The isothermic region ($T_e \approx T_n$) is situated in the altitude range $\sim$ 380-500 km during low solar activity and $\sim$ 380-650 km during high solar activity. Allowance for the nonisothermic character of the medium does not result in a change in h_mF2 and N_mF2, but causes an increase in the O^+ concentration above the isothermic region and a decrease in the H^+ concentration in a broad range of altitudes. Figures 1; references 14: 5 Russian, 9 Western. [145-5303]

GEOPHYSICAL INVARIANCE OF LOWER PART OF IONOSPHERIC F REGION

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[Abstract] The authors investigated the lower part of the ionospheric F region, taking in the altitude range 150-200 km. The analysis was made using experimental data on the profiles of electron concentration obtained by the rocket sounding method and the incoherent scattering method at different latitudes, as well as a number of empirical models. For all the considered empirical $n_e(h)$ profiles it was possible to approximate them by the elementary function

$$n_e(h) = n_e{}^m e^{-(h_e - h)/H}.$$

The universal applicability of this approximation makes it possible, on the basis of experimental data, to formulate the first invariant property of the lower part of the F region--an exponentiality of the $n_e(h)$ profiles. The next stage in the analysis was an examination of the nature of grouping of $\ln n_e$, the profile rays limited by the $\ln n_e^m$ and h_e values for different periods of day. It was found that for all states of the lower part of the F region there is a grouping of $\ln n_e(h)$ profiles into beams of rays. There is a small number of types of beams. This represents the second invariant property of the lower part of the ionospheric F region. The final stage in the analysis was an examination of the nature of combinations and movements of the profile ray in beams of different type. Parallel and intersecting

beams replace one another in accordance with the change in the twilight, day-time and nighttime periods of day. This constitutes the third invariant property of the lower part of the F region. The article concludes with two examples of use of the properties of geophysical invariance: for an artificial ionospheric inhomogeneity arising with slant movement of a macrobody with a given velocity at a particular angle to the horizon in the lower part of the F region and certain characteristics of an around-the-world radio signal. Figures 4; references 10: 6 Russian, 4 Western.
[145-5303]

LABORATORY INVESTIGATION OF WATER VAPOR TRANSMISSION FUNCTIONS IN REGION 17.5-23.5 μ m

KOZLOV, S. D., MAKAROV, A. S. and FILIPPOV, V. L.

[Abstract] Since available data on the spectral atmospheric transmission functions in the region 17.5-23.5 μm do not make possible a correct allowance for the contribution of different absorption mechanisms and do not meet practical requirements in computing atmospheric radiation transfer, the authors undertook two tasks: determining the empirical parameters of the transmission function necessary for computing atmospheric spectral transparency and investigating the dependence of radiation absorption on absolute humidity of great importance in clarifying the mechanisms which regulate absorption processes in this spectral region. Laboratory measurements were made using apparatus consisting of two identical optical multipass cells with a path variable in the range from 8 to 80 m, one of which during the experiment was filled with moist air, whereas the other was purged with dessicated nitrogen. Care was exercised that during the experiment there would be no aerosol formation in the cell and water vapor would not condense on the surface of optical elements. All measurements were made at a temperature of the surface of optical elements. All measurements were made at a temperature of 25°C with absolute humidity varying in the range $1-3 \cdot 10^3$ Pa. Forty-one observations were statistically processed for obtaining the parameters of the transmission function and ascertaining the dependence of the absorption co-efficients on absolute humidity. It was found that the dependence of the absorption coefficient on absolute humidity is governed by two factors: broadening of the water vapor absorption lines due to H_2O-H_2O collisions and absorption in the bands of associated water molecules, whose concentration is dependent on absolute humidity. Figures 1, tables 2; references 10: 5 Russian, 5 Western.
[161-5303]

THERMAL RADIATION OF STRATIFIED RANDOMLY INHOMOGENEOUS MEDIUM WITH FINITE CORRELATION RADIUS OF INHOMOGENEITIES

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[Abstract] In this investigation of the earth's thermal radiation the author examines a layered randomly inhomogeneous medium which can serve as a good model of some real structures, such as Antarctic ice. The article is essentially a continuation of an earlier published study by the same author ("Methods for Computing the Thermal Radiation of Randomly Inhomogeneous Layered Media," IZV. AN SSSR: FAO, Vol 14, No 9, pp 997-998, 1978). Here emphasis is on numerical computation of the reflection coefficient of a plane wave from a layer of a one-dimensional randomly inhomogeneous medium, a problem which allows a precise solution, but which cannot be expressed in analytical form, which therefore necessitates numerical computations, such as presented here. The approach used is an examination of a model of a one-dimensional random medium with fluctuations of the dielectric constant in the form of a telegraphic random process. A method is developed for numerical computation of the b rightness temperature of radiation on the basis of precise equations for the reflection coefficient probability density. This is followed by computations of the coefficient of reflection of electromagnetic waves from a weakly absorbing layered medium of finite thickness. All this is important because transfer theory poorly describes the propagation of waves in a medium where multiple scattering predominates over absorption. This applies, in particular, to a case of a one-dimensional medium where the correlation of transmitted and reflected waves, not taken into account by transfer theory, is most important. Figures 1; references 6: 5 Russian, 1 Western.
[161-5303]

ROLE OF SYNOPTIC FACTOR IN FORMING NATURE OF OPTICAL WEATHER

FILIPPOV, V. L. and IVANOV, V. P.

[Abstract] There is a possibility of diagnosis of the optical state of aerosol in the atmosphere and its properties in the IR spectral range on the basis of the stochastic regularities describing the interrelationship between

the optical parameters of aerosol in the visible and IR ranges and data from
standard meteorological observations. It is important to take into account
the interrelationship of the optical properties of aerosols and the synoptic
regime because the latter makes it possible to take into account the pre-
history and origin of air masses. The experiments described in this article
indicated that in haze it is necessary to distinguish at least two non-
identical states of aerosol which in the range of relative humidity 50-90%
and visibility range 5-20 km differ appreciably with respect to the nature
of attenuation of IR radiation. The first of the discriminated states of
disperse matter is observed in continental temperate air whose centers of
formation are relatively moistened forest and wooded steppe zones. The
second is observed during intrusions of returning continental temperate air
into the investigated region, the centers of whose formation were the dry
steppes and semideserts. A dispersion analysis of the aerosol in such air
masses indicated the presence of an increased concentration of particles with
r $\in$ 0.1-2.0μm in the spectrum of dry aerosol. It is clear that the optical
properties of the atmosphere are related to the position of the polar front
relative to the region where a diagnosis of optical weather must be made.
In order to identify the type of optical state of aerosol it is necessary to
introduce a synoptic criterion, in this case the position of the East European
polar front. It was found that the use of this synoptic criterion increases
the accuracy of the stochastic diagnosis by 50% in comparison with traditional
models. Tables 1; references: 11 Russian.
[184-5303]

SPORADIC LOCAL VARIABILITY OF MESOSPHERIC AEROSOL

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of Sciences

[Abstract] In an earlier article (IZV. AN SSSR: FAO, Vol 18, No 4, pp 363-
372, 1982) the authors discovered a statistically stable stratification of
aerosol formations in the mesosphere and it was found that the behavior of
aerosol at the two levels into which these formations break down is statis-
tically independent. The thickness of the aerosol formations at each of the
levels experiences a secular trend whereas a seasonal variability is
characteristic only of the formation of the lower mesosynthetic level. This
article, a development of the earlier work, is an analysis of sporadic processes
of the transformation of aerosol at both levels in the mesosphere. Measure-
ments were made during the years 1942-1952, but only during 5% of this time.
A definite criterion has been defined for analyzing the behavior of these

layers. Examples of a "quiet" gradual transformation of aerosol formations at the lower mesosynthetic level are examined, followed by examples of jump-like variability, evidence of a cloudy structure of aerosol formations. Examples of aerosol transformation at this same level over relatively long time periods are also analyzed; periods of a "quiet" gradual transformation of continuous extended structures alternate with periods of existence of cloud structures. Essentially the same picture is observed in the upper mesosynthetic layer. These phenomena occur at continental or global scales. The aerosol-forming mechanisms at the upper level reveal a strong secular trend but do not exhibit seasonal variability. It can now be considered demonstrated that twilight sounding ensures a high reliability and the necessary accuracy in determining atmospheric turbidity in the entire altitude range 40-85 km. The method of twilight sounding of high atmospheric layers can be used in a regularly operating global service for studying intraatmospheric processes. Figures 5; references: 4 Russian.
[184-5303]

SOUND PROPAGATION IN INHOMOGENEOUS MOVING ATMOSPHERE

RAZIN, A. V., Gor'kiy Scientific Research Radio Physics Institute

[Abstract] Expressions are derived which make it relatively easy to carry out an investigation of the influence of temperature gradients, wind direction and velocity on the field of a point isotropic sound source and to compare the contributions of atmospheric inhomogeneity and sound refraction in the lower layers. Since atmospheric parameters change smoothly with altitude it is proper to use the ray approximation to frequencies of tens of Hz. In computing sound intensity only the geometrical divergence of rays is taken into account. This is correct in the frequency range from tens to hundreds Hz where the effects of sound scattering and attenuation are small. First the author gives an elementary derivation of the ray equations in a plane-layered moving medium, and then ray equations in a layered-inhomogeneous moving medium. Particular attention is given to the dependence of the focusing factor on wind direction and velocity and distance from the source. It is shown that in those cases when the direction at the observation point forms an acute angle with the wind direction the focusing factor is greater than unity and its value increases with an increase in wind velocity and distance from the source. However, if the direction at the observation point forms an obtuse angle with the wind direction the focusing factor is less than unity and decreases with an increase in wind velocity and distance from the source. A comparison of the dependence of the focusing factor on the observation point azimuth in homogeneous and inhomogeneous atmospheres shows that even with a weak wind medium inhomogeneity changes the focusing factor little. The main

contribution to sound refraction in the lower layers of the atmosphere during the daytime is therefore the wind. The effects of sound refraction due to the wind and atmospheric inhomogeneity are equal in magnitude only in the case of azimuths of the observation point close to 90° when the influence of the wind is minimum. Figures 1; references 16: 6 Russian, 10 Western. [184-5303]

CONTINUUM ATTENUATION OF IR RADIATION IN TRANSPARENCY WINDOWS IN ATMOSPHERIC SURFACE LAYER

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[Abstract] The author examines existing concepts concerning the nature and physical mechanisms of attenuation of IR radiation by the atmosphere. Among the debatable questions, the following are considered: relationship of the contribution of water vapor and aerosol to the attenuation of IR radiation, nature of the nonlinear dependence of the coefficients of atmospheric attenuation σ_λ on the precipitable layer of water vapor and temperature dependence of water vapor absorption coefficients. Much material which has been published on these questions in recent years is critically reviewed and is applied in solving these problems, together with the author's own investigations. It is concluded that there is a linear dependence of the minimum effective water vapor absorption coefficients on the partial pressure of water vapor but the nature of this dependence is not entirely clear because the dependence can be partially influenced by the aerosol effect. The temperature dependence of the water vapor absorption conditions in the surface layer is within the limits of measurement error. A more important problem to consider is the possibility of determining the aerosol attenuation, which can introduce a considerable contribution into the total attenuation of IR radiation by the atmosphere. An empirical evaluation of the water vapor absorption coefficients indicated that with respect to the type of dependence on water vapor partial pressure and absolute value they agree well with data published by D. E. Burch. Figures 3, tables 3; references 20: 15 Russian, 5 Western. [184-5303]

LIGHT SIGNAL PROPAGATION IN MATTER WITH MACROSCALE RANDOM INHOMOGENEITIES
WITH ALLOWANCE FOR FLUCTUATIONS OF PHOTON PATHS DURING MULTIPLE SCATTERING

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[Abstract] The authors propose a simple analytical method for solving the
transfer equation making it possible to determine correctly the influence of
absorption and fluctuations of photon paths on the propagation of a light
signal in a turbid medium. The method made it possible to derive a relatively
simple expression for light intensity in a nonstationary signal during its
propagation through a plane layer of a scattering and absorbing medium with
macroscale inhomogeneities. It is demonstrated that in many cases the small-
angle approximation adequately describes the transmission of photons in a
medium with such macroscale inhomogeneities at any depths where the diffusional
approximation is admissible. Analysis of the solution shows that during
transmission of a light signal of a finite duration there is a region of
depths where the expression for the radiation flux ceases to be dependent on
the specific temporal shape of the input pulse and has a universal character.
Finally, a simple analytical formula is derived for the phase velocity of a
sinusoidally modulated light signal in a turbid medium at great depths.
Important cases of a stationary light flux, sinusoidally modulated and pulsed
signals are examined. The dependence of the mean square angle of deviation
of photons and the mean path of photons on their depth of penetration into
the medium was determined. Figures 2; references 15: 13 Russian, 2 Western.
[184-5303]

FINELY DISPERSE STRATOSPHERIC AND MESOSPHERIC AEROSOL

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[Abstract] The finely disperse aerosol formations in the stratosphere and
mesosphere are clearly grouped into several levels: stratosynthetic at about
20 km, lower mesosynthetic near 50 km and a doubled upper mesosynthetic layer
at 65-75 km. This stratification is stable, a permanent global phenomenon.
Mesospheric aerosol, like stratospheric aerosol, is a product of continuously
transpiring global and geophysically caused processes of formation of particles
from the gas phase. There is a rigorous stratification of aerosol-forming
processes which is an obvious consequence of the stratification of the geo-
physical mechanisms responsible for the development of these processes. The

aerosol-forming processes transpiring at different levels are statistically
independent and possibly have a different nature. Since the parameters of
the aerosol formations, including their thickness (s), are completely deter-
mined by the effectiveness of aerosol formation, that is, by the rate of
growth of particles (da/dt), the secular trend and seasonal variability of s
is a result of the trend and seasonal variability of the effectiveness of the
aerosol formation mechanism themselves. Each level owes its origin to a
specific agent: for the stratosynthetic level the agent is soft UV solar
radiation; for the lower mesosynthetic level--radiation in the range about
0.25μm; for the upper mesosynthetic level--either hard-UV or soft x- solar
radiation or air ionization by meteors. The probable reason for the seasonal
dependence of da/dt for levels at about 20 and 50 km is the seasonal vari-
ability of the time of irradiation of the upper layers by solar radiation.
The absence of such a dependence for the doubled level 65-75 km evidently
indicates a different mechanism of the formation of particles. It was
possible to obtain internally consistent approximate quantitative evaluations
of a number of the main parameters of aerosol formations in the stratosphere
and mesosphere. Figures 2, tables 1; references 29: 23 Russian, 6 Western.
[184-5303]

SIX-PARAMETER MODEL OF ZONAL ATMOSPHERIC CIRCULATION

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[Abstract] The fundamental problem which arises in describing zonal circu-
lation on the basis of the equations of hydrodynamics, averaged along a
circle of latitude, is allowance for the macroturbulence caused by the
presence of azonal disturbances of different spatial scales. Averaging leads
to an unclosed system of equations. In order to afford a new approach to
this problem the author outlines a simple hydrodynamic model of zonal circu-
lation which makes possible a qualitative reproduction of the principal
characteristics of zonal circulation. The basis of the model is a hypothesis
advanced by G. P. Williams, et al. (QUART. J. ROY. METEOROL. SOC., Vol 91,
No 390, pp 471-489, 1965): there is a proportionality of the eddy transfer
of the moment of momentum to the horizontal temperature gradient, not to the
gradient of zonal velocity. This made it possible to formulate a two-level,
six-parameter spectral model of averaged equations of a quasisolenoidal
baroclinic model of the atmosphere on a sphere with energy "inputs" and
"outputs." This model makes possible a satisfactory qualitative and quanti-
tative description of the actually observed zonal circulation. Figures 2;
references 8: 5 Russian, 3 Western.
[184-5303]

COMPARATIVE EFFECTIVENESS OF SOME ALGORITHMS FOR DISCRIMINATING AEROSOL
SCATTERING FUNCTION FROM BRIGHTNESS FUNCTION

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[Abstract] An earlier article (V. S. Antyufeyev, et al., IZV. AN SSSR:
FAO, Vol 16, No 2, pp 146-155, 1980) described a method for discriminating
the aerosol scattering function from the brightness function by precise
computations of the angular dependence of the intensity of multiply scattered
radiation by the Monte Carlo method and application of successive approxima-
tions. This article constitutes a refinement in this method undertaken for
reducing the amount of computer time for solving the problem, particularly
by taking into account the distinctive features of the problems to be solved.
In addition, a numerical study was made of the effectiveness of some successive
approximation schemes in discriminating the scattering function. First the
authors examine a number of possible modifications of the Monte Carlo method
for studying radiation transfer in a plane homogeneous layer. It is shown
that the effectiveness of Monte Carlo method algorithms can be increased
threefold by specific rather than general formulation of the problem. Three
different successive approximation schemes are examined to ascertain their
relative effectiveness when used in combination with the Monte Carlo method:
additive method, improved additive method and multiplicative method. It was
found that the relative error in evaluating the intensity of multiply scattered
radiation does not exceed 2%. With respect to the successive approximation
variant, it was found that the multiplicative scheme is most economical in
computer time, although the degree of effectiveness is dependent on the
optical state of the medium, especially the optical thickness of the layer.
The relative error in determining the aerosol function does not exceed 1-3%.
Tables 2; references: 2 Russian.
[133-5303]

MEASURING INTEGRAL ATMOSPHERIC CONTENT OF CO, CH_4 and N_2O POLLUTANTS

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[Abstract] In an earlier article (TELLUS, Vol 33, No 3, pp 262-273, 1981)
the authors proposed a two-parameter (season-latitude) model of the global

distribution of CO. Continuing this line of investigation, in this new article they give further results of spectroscopic measurements of the integral content of CO making it possible to carry out the first experimental checking of the model. The results of measurements of the atmospheric content of CH_4 and N_2O are also presented. The measurements were made from aboard the scientific research ship "Professor Zubov" in the Atlantic, Pacific and Antarctic Ocean during January-April 1981. A special diffraction spectrometer was used in registering the absorption spectra for the entire thickness of the atmosphere. The light source used was the sun. The spectral ranges, resolution and analytical lines are given in Table 1. All the results of CO and CH_4 measurements are given in Table 2; the results for N_2O are given in Table 3. For example, during the voyage from Leningrad to Antarctica and back the CO content decreased from north to south from 0.13 to 0.04 atm·cm, the CH_4 content was in the range 1.2-1.6 atm cm and the N_2O content was about 0.21 atm·cm, with no longitudinal variations being discovered in the southern hemisphere. The validity of the model proposed in the earlier article is confirmed. However, the CO content of air masses emanating from poorly populated central Africa was anomalously low in comparison with the model. This does, however, agree with the hypothesis that anthropogenic sources exert a decisive influence on the background CO content in the northern hemisphere in January-April. It can also be regarded as an indication of the need for taking into account the background content of CO in latitude zones with a longitudinally nonuniform underlying surface. The model, of course, is an averaged latitude-time distribution and fluctuations will occur, possibly in the upper range 20-25%. Figures 3, tables 3; references 13: 8 Russian, 5 Western. [193-5303]

NATURE OF VOLATILE AND NONVOLATILE COMPONENTS OF SUBMICRON NATURAL AEROSOL

LYUBOVTSEVA, Yu. S. and YUDIN, N. I., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] In an earlier study (IZV. AN SSSR: FAO, Vol 17, pp 716-724, 1981) the author proposed a thermooptical method for investigating the submicron fraction of aerosol which makes it possible to determine the change in the chemical composition of this fraction with quite small time averaging (about 15 minutes). This method involves continuous registry of the σ-volume coefficient of scattering by aerosol with gradual heating of the aerosol to 200°C and thereby determination of the contribution to scattering from the volatile and nonvolatile substances forming aerosol particles. The work was done within the framework of the Abastumani (Soviet-American) background aerosol experiment (AFAEKS-79). This study took in measurements of the mass

concentration of aerosol, including measurements of its different fractions, and a quantitative determination of the elements and ions in these particles. Measurements of the mass concentration of dry submicron particles $(0 < d < 2.5 \mu m)$ and their volumetric concentration were compared. This in turn made it possible to compute the volumetric concentrations of the volatile and nonvolatile components of the submicron fraction. Thermooptical and chemical analyses of the submicron particles were compared. It was found that the main contribution to the mass of the dry component of submicron particles is from ammonium sulfate (also simple carbon and organic compounds). A method was developed for the rapid evaluation of the concentration of sulfate compounds in aerosol by optical measurements. The thermooptical method makes possible a detailed study of the dynamics of the content of sulfates in aerosol, as is necessary for clarifying the mechanisms of transformation of aerosol particles. The nonvolatile fraction consists of two main components: soot and organic. A table gives the variations of the main components of submicron particles. Figures 4, tables 1; references 12: 8 Russian, 4 Western.
[193-5303]

ROLE OF ORGANIC AEROSOLS IN ATMOSPHERIC ATTENUATION OF INFRARED RADIATION

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[Abstract] A detail investigation was made of the contributions of the two principal fractions of aerosol (fine and coarse) to the atmospheric attenuation of IR radiation. Investigations of the IR absorption spectra of organic substances detected in atmospheric aerosols have been made at Leningrad State University for four years. It was found that there is a high stability of structure of these spectra. There is a seasonal variability of the intensity of the absorption bands and accordingly in the content of the corresponding substances with a maximum in late May-early July and a diurnal variation with a maximum at about 1700-1800 hours. For the diurnal variation there is a direct dependence of the intensity of the absorption bands on direct solar radiation. This diurnal variation of the content of organic substances in aerosols does not correspond to the diurnal variation of the total content of aerosols in the atmosphere. Most organic substances detected from the IR absorption spectra are in the fine particles $(r < 0.07 \mu m)$. A quantitative determination was made of the content of organic substances in the aerosol. The analytical method used was described in another article (Andreyev, S. D., PROBLEMY FIZIKI ATMOSFERY, No 17 (in press)). The measure used for the content of organic substances in a sample was optical density in the absorption band in the region 2750-3100 cm^{-1}. It is noted that the evaluation was made only for those organic substances in aerosol which are soluble in carbon tetrachloride. The authors determined the absorption index for this fraction and estimated the concentration of organic substances in a disperse state.

The coefficients of attenuation of the fine disperse aerosol fraction are estimated. The contribution of this fraction to the attenuation of IR radiation in the range 2-15 μm is 1-1 1/2 order of magnitude less than the contribution of mineral (mainly coarse disperse) particles. This is considerably less than has been suggested in the literature. Figures 2; references 13: 9 Russian, 4 Western.
[193-5303]

RELATIVE INCREASE IN RADIATION ATTENUATION LENGTH AS RESULT OF CORRELATION OF WEAK SCATTERERS

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[Abstract] The author examines the effect of paired correlations of scatterers in the theory of transfer of monochromatic radiation. The point of departure is the transfer equation with allowance for correlations of scatterers of all orders, obtained from the Helmholtz wave scalar stochastic equation. In the first part of the paper it is shown that in the case of weak scatterers a significant contribution to the scattering coefficient of the transfer equation is made only by their paired correlations. The scattering coefficient is expressed through a parameter which in the statistical mechanics of gases and fluids is known as the structure factor. The second part of the paper makes use of the value of the structure factor for a system of solid spheres. By analysis of the structure factor a study is made of the influence of correlations of scatterers on the value of the radiation attenuation length, angular divergence and broadening of the wave beam. The structure factor of an ensemble of scatterers with dense packing assumes small values in comparison with unity in the case of small values of its argument. As a result, the radiation attenuation length in the case of small-scale scatterers can exceed its value for a model of uncorrelated scatterers by several times. A similar relative increase in the attenuation length in the case of large-scale scatterers is dependent on the ratio of the minimum distance between the centers of the scatterers to their optical diameter and on the degree of smoothness of the dielectric constant of the scatterer as a function of coordinates. Figures 1, tables 2; references 13: 11 Russian, 2 Western.
[193-5303]

EQUATIONS FOR PASSIVE OPTICAL SOUNDING IN HOMOGENEOUS ATMOSPHERE

KABANOV, M. V. and SAKERIN, S. M., Institute of Atmospheric Optics, Siberian
Department, USSR Academy of Sciences

[Abstract] The authors derive and analyze equations for the transfer of
brightnesses of remote objects in a scattering, absorbing and radiating
homogeneous, plane-parallel, infinite atmosphere on the basis of the general
equations of radiation transfer. These are the initial equations used in
developing passive methods for optical sounding of the atmosphere on horizon-
tal paths in remote sounding of gas and aerosol pollutants in the surface
atmosphere and can also be employed in the theory of optical visibility of
remote objects and the optical horizon. A full validation of these equations
is presented. The influence of cloud cover and the screening effect of the
observed object on the limits of applicability of the passive sounding equation
is evaluated. Geometrical relationships are analyzed for a scheme of passive
sounding on extended paths; these relate the length of the photometrically
measured path and the sighting angle, taking into account the earth's spher-
icity and refraction. The possible application of the passive sounding equa-
tions is considered. They are particularly effective, for example, in
measurements at sea where the use of traditional base methods is virtually
impossible. They afford an essentially new approach for the detection or
monitoring of atmospheric pollutants. Figures 4; references: 14 Russian.
[193-5303]

DISTRIBUTION OF SUSPENDED PARTICLES IN STABLY STRATIFIED UPPER ATMOSPHERE

TEPTIN, G. M. and MOROZOVA, L. V., Kazan' State University

[Abstract] The theory of settling of suspended particles in a temperature-
inhomogeneous atmosphere has been applied in an effort to obtain further
estimates of the concentration of particles and the seasonal and day-to-day
variations of this concentration observable in the altitude range 70-105 km.
The relationship between the intensity of turbulent energy and the concentra-
tion of suspended particles is investigated in this range in order to under-
stand the factors responsible for the observed variations. Quantitative

computations give a concentration at 90 km, for example, of $5 \cdot 10^8$ particles/m^3 with a log-normal distribution law. In actuality, it was discovered that the particle concentration may be described by two distribution laws, the governing factor being the radius of the particles (power law or log-normal law). As the next logical point of study, the authors ascertained the limits of the interval of particle sizes supported by the energy of turbulent movements. After examining the pertinent stationarity conditions it was concluded that the computed concentrations are in good agreement with experimental data. In all probability there is a temporal and altitudinal variability of the parameters of distributions of suspended particles as well as a change in the overall concentration during the course of the day and from season to season, changes in turbulent energy being the governing factor. Figures 4, tables 2; references 25: 15 Russian, 10 Western.
[193-5303]

ATMOSPHERIC PRESSURE FLUCTUATIONS AND GEOMAGNETIC VARIATIONS CAUSED BY DYNAMICS OF ATMOSPHERIC FRONTS

BYCHKOV, V. S., Water Problems Institute, USSR Academy of Sciences

[Abstract] Atmospheric fronts generate internal gravitational waves which upon reaching the ionosphere cause magnetic variations. Turbulent movements in the lower atmosphere are responsible for magnetic field pulsations. The author has determined the real parameters of internal gravitational waves registered at the earth's surface in the form of pressure fluctuations in the range of periods from 5 minutes to 2 hours. Registry was with a quartz microbarograph with a mean response 0.03 mbar/mm. Geomagnetic variations with a mean rate 0.1 γ/mm were registered at the same time. Registry was with a quartz variometer. The synchronous records of pressure and geomagnetic variations consist of 120-day observations made in the Caspain Sea area and 90-day observations made in Cuba. Statistical processing revealed that the pressure fluctuations contain oscillations in the range of periods from 10 to 120 minutes with amplitudes from 0.2 to 1.2 mbar. The periods of the geomagnetic variations were similar to the mean periods of atmospheric pressure, whereas the amplitudes on magnetically quiet days were 1.2 to 5.2 γ. All data were subjected to spectral analysis using a program based on the fast Fourier method with a low-frequency filter in order to eliminate regular tidal components of atmospheric variations and geomagnetic variations. The purpose of the spectral and statistical analyses was to find the correlation between two random processes, one transpiring in the troposphere and the other at an altitude of 60-100 km in the region of ionized atmospheric layers. An analysis was made of changes in the parameters of pressure fluctuations and geomagnetic variations, taking into account the direction and velocity of

movement of atmospheric fronts. Six typical synoptic situations for the
Caspian Sea basin were considered, two of them being examined here in detail.
These examples reveal that synoptic activity can exert an influence on the
amplitude-frequency characteristics of the variable magnetic field, increasing
as the front approaches the observation point. These changes occur with
approach of a front to a distance of 500-2000 km from the observation point.
The periods of the geomagnetic variations increase by 1-3 minutes and the
amplitudes increase by tenths of a gamma. Figures 3, tables 1; references:
5 Russian.
[193-5303]

STATISTICAL MODELING OF IMAGE OF THREE-DIMENSIONAL OBJECTS IN VISIBILITY
THEORY PROBLEMS

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Academy of Sciences

[Abstract] The problem of visibility of objects through scattering media
is examined. There are three general approaches to solution of the problems
involved in the transfer of an image through scattering media. One of these
is the linear-systemic approach: the scattering medium is regarded as an
element of the observation system and its influence on the characteristics
of the medium is evaluated with allowance for the parameters of an ideal
variant of a specific optical instrument forming the image of the object.
The advantage of the linear-systemic approach is that it is possible to take
into account the characteristics of image formation by optical systems. The
article examines the possibilities of allowance for the influence of the
spatial extent of the medium on image characteristics in a scheme for the
photographing of plane diffusely reflecting (emitting) objects through a
layer of scattering medium. A problem of this nature is formulated and
solved, making use of the Monte Carlo method. The solution hinges closely
on the algorithm for "point-spread functions" proposed by the author in OPT.
LETTERS, Vol 4, No 5, pp 158-160, 1979, but supplemented by procedures for
avaluating the size of the scattering spot and determining the contribution
of radiation from each scattering point to the illumination histogram (in the
image plane). These procedures are quite simple since the scattering spot is
circular and the distribution of illumination within the scattering circle
is uniform. An example of application of this algorithm is given. The proposed
method can be useful in solving problems in optical sounding of scattering
media when the entry element of the receiving system is a focusing device
and the receiver is situated close to or in the scattering medium. Figures
1, tables 1; references 6: 5 Russian, 1 Western.
[151-5303]

EFFECT OF UNCERTAINTY OF OPTICAL CONSTANTS ON ACCURACY OF PHOTOELECTRIC
AEROSOL COUNTERS

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[Abstract] Photoelectric particle counters are now used in studying the
microstructure of aerosol; these are calibrated using spherical aerosol
particles with a known chemical composition and size. But in the atmosphere
there are significant variations in chemical composition and particle shape.
For an analysis of the errors in determining the microstructure of aerosol
caused by such variations in chemical composition the authors made theoretical
evaluations of the influence of the optical constants (refraction and absorp-
tion indices) on the readings of the photoelectric counters. Specifically,
the article gives the results of computations on the basis of the precise
theory of scattering of radiation by a spherical homogeneous particle,
making it possible to make evaluations of the influence of the optical
constants of the particles on variations of signals of photoelectric particle
counters of different geometry with irradiation of the scattering particles
by the collimated monochromatic radiation of a laser. The optical systems of
photoelectric particle counters of four main types were examined: 90° counters,
with a collecting aperture in the forward hemisphere, counters registering
scattered light in the rear hemisphere, integral counters collecting the
radiation scattered by a particle at the maximum possible solid angle. Data
are given on the influence of the refraction and absorption indices on the
signals of photoelectric particle counters of different geometry. The data
clearly show a significant influence of the optical constants on counter
signals. The different types of counters are compared and it was found that
integral counters and counters with a receiving aperture in the forward hemi-
sphere ensure a higher accuracy in determining the distribution function in
the entire considered range of sizes. Correct data on the microstructure of
particles requires monitoring of the chemical composition of aerosol; an
increase in the accuracy of measurement of the disperse composition can be
based on the creation of designs of counters taking into account the variability
of the optical constants. Figures 1, tables 1; references 6: 3 Russian,
3 Western.
[151-5303]

AEROSOL STRATIFICATION AND ITS VARIABILITY

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Atmospheric Physics, USSR Academy of Sciences; Abastumani Astrophysical
Observatory, Georgian Academy of Sciences; Atomic Energy Institute imeni
I. V. Kurchatov

[Abstract] During the last 10 years an extensive literature has been pub-
lished on the stratification of aerosols. On this basis, and the systematic
observations made at Abastumani, all this material is integrated and new
conclusions are drawn. Much of the latest information is based on twilight
observations and observations of the earth's aureole from manned spacecraft.
The overall picture of aerosol stratification to an altitude of 85 km is
illustrated in Fig. 1. On a global scale aerosol formations are separated
into several genetically unrelated levels having a statistically independent
existence and separated by statistically stable zones relatively free of
aerosol. One of the most important contributions of Abastumani scientists
in the field of analysis of this stratification is the introduction of the
"C_i" coefficient, which is highly important in analyzing the behavior of
aerosol at different levels. The turbidity of mesospheric levels at about
50 and 65-75 km varies only slightly--by a factor of 1.5-2, whereas for the
stratospheric level at about 10 km there is an extremely strong variability.
The secular trend of the mean annual values reflects the natural variability
of the state of aerosol--the existence of quite intense sporadic and relatively
rapidly transpiring processes of the development and decay of aerosol forma-
tions. There is no 11-year cycle in the layers corresponding to the solar
activity cycle. The annual variation of mean monthly C_i values reveals a
clear seasonal dependence of C_i; there is a considerable increase in the
density of stratospheric aerosol formations during the summer months. The
seasonal effect is expressed less clearly for the mesospheric aerosol at the
middle level. There is no seasonal effect for the upper doubled level at
65-75 km; there is also no correlation with meteor streams. It was surprising
that there is no distinct influence of volcanic eruptions on the mean annual
values. Figures 6; references: 14 Russian.
[151-5303]

THERMAL SELF-IGNITION IN ARTIFICIAL CLOUD IN UPPER ATMOSPHERE

GERSHENZON, Yu. M., KONOPLEV, A. V. and CHEKIN, S. K., Institute of Physical
Chemistry, USSR Academy of Sciences

[Abstract] A new model of an artificial luminescent cloud is proposed which
explains the qualitative difference between C_2H_4 and NO artificial clouds.
With the injection of NO the released energy is expended almost completely
in the excitation of products, not in heat release. The injection of NO in
the upper atmosphere does not cause an appreciable temperature change in the
cloud zone and the forming cloud is described qualitatively by a diffusional
model. However, with the injection of organic compounds in describing the
process of cloud development it is necessary to take heat release into account.
This is particularly important when determining the physical and chemical
parameters of the upper atmosphere since thermal self-ignition leads to their
considerable change in the cloud zone. The article gives a model of an
ethylene luminescent cloud based on the kinetic equations of the principal
chemical reactions transpiring during the injection of ethylene, diffusion
equations for each component of the system, thermal conductivity equation and
equation of state. Applying the approximate Frank-Kamenetskiy theory, it was
found that with the injection of ethylene in the upper atmosphere at altitudes
105-140 km its thermal self-ignition occurs. Computations on the basis of the
model of an ethylene cloud at 110 km confirms the self-ignition of ethylene
at that altitude. There is a satisfactory agreement between the total in-
duction time for the thermal explosion computed using the approximate theory
and the mathematical model. This thermal explosion effect should be observed
with the injection of a wide range of reagents which interact with oxygen atoms
with heat release. Figures 2, tables 2; references 7: 5 Russian, 2 Western.
[151-5303]

ATMOSPHERIC HAZE MICROSTRUCTURE

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of Sciences

[Abstract] In an earlier article (SOOBSHCHENIYA AN GSSR, 104, No 3, 1981) the
authors described a two-ray photoelectric particle counter for simultaneous
measurement of the size and refractive index of the matter in atmospheric

aerosol particles. Using this and other counters the authors now give the
results of measurements of the size distribution of the submicron fraction of
aerosol particles. Measurements of the size distribution of particles were
made in the range of change in radius a = 0.3-2.0 μm with an interval
Δ a = 0.15 μm. The two-ray counter was used in conjunction with two photo-
meters. The first photometer (scattering angle φ = 40°) was used in measuring
the distribution function in the range of radii 0.3-1.5 m and the second
(φ = 140°) was used in making measurements in the range 0.75-2.0 μm. The
article gives example of the results of measurements of the particle distri-
bution density n(a) in the Moscow region for visibility ranges $S_M \simeq$ 20 km and
$\simeq$ 5 km. With the greater range the distribution function is represented
satisfactorily by a Junge distribution; for the lesser range--by a distribution
function with a single peak, such as a log-normal distribution. Transformation
of aerosol microstructure with a change in humidity is traced on the basis of
the change in the distribution of volumes by size v(a) = $4\pi/3$ a^3n(a).
Measurements of v(a) are given for both natural aerosol and its dry fraction
for relative humidities of 90 and 96% for the same air mass. It was found
that there is a significant dependence of the condensational activity of
aerosol on particle size; the refractive index is also dependent on particle
size. Important data on the processes of aerosol transformation can be ob-
tained in a study of the diurnal variation of its optical and microphysical
characteristics. The concentrations of particles of close sizes do not always
change consistently. With time there is also a change in the absolute value
and relative degree of condensational activity of aerosol. With a change in
relative humidity the form of relief of the two-dimensional distribution of
particle size and refractive index changes, attributable primarily to a change
in the refractive index of the particles. Figures 4: references: 3 Russian.
[187-5303]

CORRELATION BETWEEN LIGHT SCATTERING COEFFICIENT IN SURFACE LAYER AND ABSOLUTE
AIR HUMIDITY

SIDOROV, V. N., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] The presently available data on the existence and nature of the
correlation between the optical characteristics of atmospheric aerosol and
absolute humidity are contradictory. In an effort to overcome this problem
investigations along these lines were carried out at Abastumani in August
1978. Around-the-clock measurements of light scattering matrices made it
possible to trace the quite prolonged process of transformation of the sub-
micron aerosol fraction during periods of thickening and thinning of atmospheric
haze during considerable day-to-day changes in meteorological parameters. The
method employed made it possible to ascertain the influence exerted on aerosol

by relative humidity and at the same time investigate other factors respon-
sible for aerosol variations in the surface layer. The article gives data
on the coefficient of directed light scattering D$\equiv$D at an angle φ = 45°
for winter for a light wavelength of 546 nm and the degree of maximum polar-
ization of scattered light (100°) obtained during prevalence of a stable air
mass. These data were compared with parallel measurements of absolute air
humidity a. Air was sampled at $\sim$ 3.5 m above the underlying surface. A
correlation analysis of the D and a values did not reveal a significant
correlation, except in cases when a radiation type of weather prevailed.
Intensive turbulent mixing of air observed during the daytime during clear
weather or weather with few clouds is the dominant process determining the
content of aerosol and water vapor in the lower part of the surface layer,
resulting in synchronous changes in D and a. At nighttime, when atmospheric
turbulence is considerably attenuated, aerosol and absolute humidity varia-
tions are determined by other factors and there is no correlation between D
and a. Figures 2; references: 12 Russian.
[174-5303]

LIGHT SCATTERING FUNCTION IN CLOUDLESS ATMOSPHERE

BAZALITSKAYA, G. P. and LIVSHITS, G. Sh., Kazakh Pedagogic Institute

[Abstract] The models of the standard atmosphere proposed in recent years
contain a considerable number of optical parameters, but until now the problem
of the choice of a standard light scattering function in the cloudless
atmosphere remains unsolved. The scattering functions obtained by
R. A. McClatchey, et al. were obtained on the basis of theoretical computations
of the optical characteristics of prestipulated aerosol models which are far
from real. The authors sought to obtain full scattering functions in a
broader wavelength range (from 0.3 to 2.6 μ m) than in any earlier investiga-
tion for different conditions of atmospheric turbidity. A formula is derived
for the complete normalized scattering functions for the entire cloudless
atmosphere. The turbidity factor T, determined using the formula T =
$(\tau_a + \tau_R/\tau_R$, for λ = 0.55 μm, is assumed equal to 2, 4 and 6. For all three
cases the aerosol optical thicknesses were equal to τ_R, $3\tau_R$ and $5\tau_R$
respectively. Table 1 gives the mean normalized aerosol scattering functions
computed using the Elterman model; Table 2 gives the normalized scattering
functions for the cloudless atmosphere computed for the entire thickness of
the atmosphere; Table 3 gives the spectral dependences of optical parameters
with different turbidity factors. The normalized functions and the optical
thicknesses are necessary for computing the field of scattered radiation in
the cloudless atmosphere. Computations are not difficult and the main problem
is proper choice of the parameters. The three tables considerably supplement
and refine the standard optical model of the cloudless atmosphere. Tables 3;
references 7: 4 Russian, 3 Western.
[174-5303]

WAVE SOLUTIONS OF QUASIGEOSTROPHIC VORTICITY EQUATION

KORNYAK, V. V., Kuban State University

[Abstract] Long moving waves, with wave numbers in a zontal direction
n = 5-10, transport a great quantity of kinetic and potential energy. These
waves arise primarily under the influence of baroclinic instability of the
circumpolar flow and are responsible for baroclinic atmospheric processes.
As pointed out by the author, the nature of these formations indicates that
they can be described quite well by a wave with one phase function and
accordingly this article is devoted to an examination of baroclinic waves
described by a single phase, as a point of departure using the quasigeostrophic
potential vorticity equation in an isobaric coordinate system in the β-plane
approximation. Wave solutions of this equation are found and it is shown that
the class of asymptotic solutions contains a subclass of precise solutions.
These wave solutions of the quasigeostrophic potential vorticity equation in
the first approximation have the form of sinusoidal waves of an arbitrary
amplitude, with the amplitude increasing with altitude on the average as
$p^{-1/2}$ for the considered structure of vertical stratification of the atmosphere.
References: 5 Russian.
[174-5303]

RADIATION TRANSFER BASE EQUATIONS IN HORIZONTALLY INHOMOGENEOUS SCATTERING
MEDIUM

ROMANOVA, L. M., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] The scattering coefficient σ in clouds is dependent on both the
level z and on the horizontal coordinates x, y; the dependence of σ on
horizontal coordinates in stratiform clouds has an oscillatory character.
In order to clarify this matter, the author here proposes that in such clouds
the scattering coefficient can be represented as a function of x and y by a
segment of a double Fourier series. As a simplification, as a point of de-
parture, it can be assumed that the coefficients of this series are not
dependent on the vertical coordinate z. The perturbations method can be used
in solving the radiation transfer equation with such a scattering coefficient;
the problem for a horizontally-homogeneous cloud is first solved. Each term
in the perturbations series is expanded into a double Fourier series in x, y
and the transfer equations for the coefficients of these series are written

in vector form. The next step is the expansion of all the matrix operators in these equations in a system of base matrices representing a group of transforms of a four-dimensional vector formed from the Fourier coefficients of the scattering coefficient. The article then shows that the solution of these equations is possible by finding the solutions of a series of recurrent equations not dependent on the form of the horizontal variations of the scattering coefficient and subsequent superposing of these base solutions with the coefficients determined by horizontal variations of the scattering coefficient. References: 4 Russian.
[174-5303]

SPORADIC MESOSCALE VARIABILITY OF STRATOSPHERIC AEROSOL

MEGRELISHVILI, T. G., MEL'NIKOVA, I. G. and ROZENBERG, G. V., Abastumani Astrophysical Observatory, Georgian Academy of Sciences; Atomic Energy Institute imeni I. V. Kurchatov; Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] A study was made of the characteristics of sporadic relatively rapidly transpiring (several days or weeks) variability of aerosol formations in the stratosphere detectable with mesoscale averaging of about 500 km. The approach used was a study of twilight phenomena observed from the earth's surface and space. As pointed out in earlier research by the authors, in this case the measurable parameter applicable to stratospheric formations is only their integral characteristic, specifically, the altitude of their effective screening of rays tangent to the earth's surface. The initial data used in the investigation included both twilight measurements at Abastumani and an analysis of the light structure of the glow observed from the orbital station "Salyut-6." These observations clearly revealed the existence of sporadic mesoscale processes of variability of aerosol formations in the stratosphere, including the rapidly transpiring processes of its "self-purification" over a long period of time. During periods of stratospheric warming there is a brief destruction and even a disappearance of aerosol formations in the stratosphere, followed by their rapid restoration, the entire process taking about 2 weeks. It is clear that aerosol at the stratospheric level reacts sensitively to changes in meteorological conditions in the stratosphere, but the mechanisms of this reaction remain unclear. Figures 5; references: 13 Russian.
[174-5303]

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